THE

ELECTRICAL REVIEW.

VOL. LXXIV. APRIL 3, 1914. No. 1,897.

ELECTRICAL REVIEW.

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	Page
The Dispute in the Electrical Trade	561
Lead	562
Vibration of Machinery	562
Electric Light and Power on the Petroleum Fields, by F. B. Lea	563
Notes from Canada	564
Correspondence—	
The Lighting of the I.E.E. Theatre	565
Maintaining High Power Factor	566
Crane Motors at the County Hall	566
Load, Strength, Stress and Strain	566
Appointment of an Assistant Electrical Engineer ...	567
The Policy of the A.E.S.E.	567
Railway Rates and Charges	567
Legal...	568
Our Legal Query Column	570
The Electrical Trades Benevolent Institution	570
Business Notes	571
Notes...	578
The 2,400-volt Direct-Current Electrification of the Butte, Anaconda and Pacific Railway, U.S.A. (*illus.*) (*concluded*)...	579
City Notes	585
Stocks and Shares	590
Market Quotations	590
Share List of Electrical Companies	591
Motor and Control Equipments for Electric Locomotives ...	593
Electric Battery Vehicles...	593
The Manufacture of Tungsten Filaments (*illus.*)	595
Electric Winding at Collieries	596
New Electrical Devices, Fittings and Plant (*illus.*)	597
Parliamentary	599
Foreign and Colonial Tariffs on Electrical Goods	599
New Patents Applied For, 1914	600
Abstracts of Published Specifications	600
Contractors' Column ... Advertisement pages xxii and xxiv	

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NOW READY.

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THE DISPUTE IN THE ELECTRICAL TRADE.

THERE has been a great deal of comment in the public Press during the past few days on the dispute between the Electrical Trades Union and the London Electrical Masters' Association and its possibilities. It is impossible for technical journals to get on the track of all the absurd statements that are made at such a time as this. Were it likely to be of any avail in relieving the present position, we would stop now to correct some of them. So far as our readers are concerned, we have kept them informed regarding the limited character of the dispute.

The strike has now actually begun, the E.T.U. having selected Wednesday, April 1st, as the day upon which their men would lay down their tools. Our readers will judge for themselves whether, considering all the circumstances, the date be appropriate. At the time of writing, we learn that a number of men were discharged on Tuesday night, and about 400 struck work on Wednesday morning.

For some time our columns have borne evidence to the growing friction, and we much regret that negotiations for peace have failed. We hope, however, that wise counsels will soon prevail, and that a small Committee, on which both masters and men are represented, presided over, if necessary, by an impartial chairman, will thoroughly discuss the points at issue.

As regards wages and hours, the differences should soon be surmounted. The men ask for 11d. per hour as a minimum for electrical fitters and wiremen, the masters offer for wiremen 10d. per hour from the first pay-day in April to the first pay-day in July, and 10½d. thereafter, so that practically there is only ½d. per hour between the parties. As regards hours, the men ask for a working week of 50 hours, and the masters stipulate that the recognised working hour shall not exceed 53 hours per week.

There are, however, two further points on which, up to the present, no working compromise has been suggested. It is well known that in modern conduit wiring work a considerable proportion of the total labour consists in the preparing and fitting in position of the conduits and accessories. The masters claim that men employed solely on this work shall be termed "pipe-fitters" and paid at the rate of 9d. per hour. This differentiation between the workers has been in force for some time, as it is clearly stated in the rules prepared by the Electrical Contractors' Association in January, 1912.

The men strongly object to this clause. They state that it would be possible by a rigid interpretation of this stipulation to displace 70 per cent. of the higher-paid workmen, as wiremen need only be sent to a job to run the wires through previously prepared conduit runs. It is to be hoped that a working compromise on this point may soon be arranged by such a committee as we have suggested. Safeguards should be introduced to prevent the masters lowering the standard of the work done, while at the same time the men should be prepared to allow the preliminary unskilled part of the work to be done by the lower-paid hands. The Union's organiser is credited with the admission that the pipe-fitter's rule will affect only a few large firms—four or five. Are we to understand, then, that this limited number employ 70 per cent. of the higher-paid workmen?

The remaining point is an old one as regards Trade Union disputes, and in this case it is more important than all the others. The masters claim liberty to employ whom they will, whether they belong to a Trade Union or not; the men stipulate that Trade Unionists shall not be asked to work with non-unionists. This is a point on which the

masters cannot be expected to give way. At the present time there are a large number of thoroughly competent men who deliberately stay outside the Trade Union, and to become parties to an attempt to force them into the Union by applying the pressure of dismissal from long-held situations would be a breach of faith which we do not believe the masters will contemplate for a moment.

The situation at the present time needs very careful handling, but, given the right body and the right atmosphere, it should not be impossible to find a *via media* acceptable to all but the extremists on either side. Unfortunately, however, the extremists are as usual very much in evidence. Originally the men declared that the masters were out to "smash" the Union. Now the Union says that it is out to "hit" the masters. We are not likely to get any "forrader" while this sort of talk is indulged in. It is the Union's way of saying that it is not anxious to cause the public any inconvenience. It disclaims any desire to do so "unless necessity arises." This present regard for the public welfare is interesting when we recall that the Union would have been delighted a few weeks ago at the prospect of holding up London's electricity, if the central-station men had fallen at its bidding.

Lead.

There has been a decided development of uneasiness in the lead market, caused in the first instance from the news filtering out that fair quantities of American domestic lead had been sold for export to Europe. The initial sales of the kind were not important, comprising merely 100 short tons of Missouri lead from the Saint Joseph Co. to London, but this lead was followed by other and more important quantities, and at the time of writing lead from America has come into Liverpool, Manchester and Bristol, which is taken to mean that there is a moderate quantity of metal in the United States available for shipment to the European centres. No doubt further shipments depend to a very large extent upon the prices relatively ruling in New York and London. If the London price moves up to about £20, while that in New York remains round 4 cents a lb., there is no question that it would suit America very well to sell to the English outports such as Liverpool, Bristol, &c., but the drop in London has put further business on the shelf for the present again, though there is always a chance of some fresh move to allow of further sales. Enthusiasm in the market has been very much checked, however, by the development of events, and there is no more talk of squeezes such as those which have been a recurring factor for months past in the market. What is more, not only has American lead come here in moderate quantities, but the arrivals of Australian and Spanish lead have been on a more liberal scale, and there are good quantities afloat now for the consuming centres, all of which tends to show that there has come a pause in the tightness of the metal. There can be no doubt that the selling of American lead for export took many people by surprise, and there was some scepticism expressed as to the accuracy of the earliest statements made regarding the quantities of the metal which had been sold. There is abundant evidence now, however, plain for all men to see, that the original estimates erred, if at all, on the side of moderation, while there are fair quantities yet to be shipped. So far, however, there is not any excess of material about here, but the tendency of the market at large has been affected unfavourably. If the United States, which ordinarily is dependent to a considerable extent upon imports from Mexico of silver lead, can not only do without supplies from this quarter, but can actually spare lead refined from Missouri ores for shipment abroad, there can be not the least doubt as to the extent to which general trade across the Atlantic has been suffering recently. There is always the hope that things in this respect will improve, and, indeed, a general strengthening of the industrial position in respect of all metals is long overdue, but it is unlikely that there can be any material and defined alteration for the better until the railway rates decision is safely out of the way. The point of main importance in considering the United States situation is the position of the railway companies. These have stood sullenly aloof from buying for many months now, and if there is to be a persistence of this attitude for the rest of the year, it is quite hopeless to look for an improvement of any substantial character in trade, especially metals. If, however, there is to be a permitted raising of rates, the immediate result should be an enormous buying movement, for railway orders have been withheld till the stores are depleted, and not only have replacements become urgent, but there has been an absolute standstill in new construction. Hence the near future rests very largely on the attitude of the railways. Meantime lead is not likely to improve much until confidence is restored, and this cannot occur till the United States position is regarded as having materially improved with the disappearance of the possibilities of further sales from across the Atlantic.

Vibration of Machinery.

Are engineers fully alive to all the new conditions by which they are surrounded? The environment of an engineer's profession and experience is a very fluent quantity. It is constantly changing. A case of nuisance recently passed through the Courts in which the plaintiff sought protection from the noise of machinery in an adjoining premises, there being a party wall. It appears that this heavy party wall was in close and firm connection with the hard concrete floor on which stood the machine which was productive of the worst of the noise. There was a steel and concrete ceiling above, also in firm connection with the wall. Inside the workshop there was by no means a particularly serious amount of noise, and what there was came mostly from details such as iron trolley wheels running on the concrete floor, and therefore easily preventable by the use of rubber tires. The least noticeable noise came from a machine in which were certain gear wheels. The work of the machine was variable in cycles of two seconds, and resulted in a force which for a few degrees of arc caused the driven wheels to become the drivers, thus producing the familiar sound of backlash in the backward contact of the teeth and again when running forward. Inside the plaintiff's premises, however, this backlash was extremely noticeable, and especially so since it occurred off and on from 8 p.m. to 4 a.m., with periodical intervals. And as usual with running machinery, whether it be a clock or a marine engine, it is the stoppage which is more noticeable than the running. A sleeper does not become accustomed to alternations of sound and stillness, though he may become used to a noise, more particularly if it be steady and continuous in volume.

It appeared from the evidence of the engineers called by the plaintiff that the trouble of noise arose from the conveyance of the sound in the workshop by the very solid continuous structure of the concrete and steel ceiling and floor. Of course, no place intended to be used as a workshop, more particularly for night work, should be solidly connected to a dwelling house and be a party to the dividing wall. There should be two dividing walls, with a sound-deadening filling in between, and no connection whatever to transmit the molecular vibration of sound.

It appears to be the case that homogeneously solid ferro-concrete buildings transmit sound very freely and loudly throughout their structure. In an ordinary building, with beams and joists merely resting on walls which are not too solidly compounded of small bricks with mortar joints, there is a reduction of vibration at every joint and at every change of material and structural continuity. Engineers should be alive to the new state of affairs, which has come into play since the introduction of ferro-concrete work. This material is so hard and firm and continuous, that the transmission of sound takes place through it with great facility, and solid walls and floors become transmitters of sound to the air, for their continuous surfaces become sounding boards or tympana. There is nothing to retard transmission and to muffle its sharpness in the way that a wooden joist will do when resting on a brick wall.

The question of sound should be studied with care in new buildings, for it is likely to become serious in the future.

ELECTRIC LIGHT AND POWER ON THE PETROLEUM FIELDS.

By FRANK B. LEA, B.A.

In the enormous developments that are taking place throughout the world in all the numerous petroleum or crude oil producing territories—themselves receiving additions almost every month—it is not surprising that there should be also a greatly increased use of electric light and power to enable the work of drilling, bailing, and pumping to be carried on continuously, and with greater safety and economy than could otherwise be done.

The advantages of electric working are obvious in regard to both these directions—light and power. Bearing in mind the dangerous nature of an oilfield, where there are, as a rule, large quantities of highly inflammable hydrocarbon gases nearly always rising from the bore holes and permeating the whole region (being heavier than air), there can be no two opinions as to the absolute necessity for installing incandescent electric light in the derricks and on the field generally if continuous working is to be adopted in the way that every oil engineer desires.

Otherwise, drilling, bailing, and pumping could only be carried on properly so long as daylight lasts, and the absurdity of closing down the work of drilling at nightfall, when ill-chance may find the field engineer in the middle of a ticklish bit of repair work, or anxious to keep the casing in movement lest it should stick, must be obvious even to the non-technical man who has never seen an oil well.

No other mode of artificial illumination could be entertained for this purpose, and the sole aim of the electrical engineer controlling a supply to the oilfields—whether individual or general—is to make sure that no conceivable defective switching or other contact shall at any time give rise to spark or flash communicating with the highly explosive mixture of gas and air which may at the moment very likely permeate the whole neighbourhood.

Efforts have been made by the mining authorities in more than one field to ensure greater safety in this direction by insisting that every individual switch—no matter what its size—shall make and break under oil; but, needless to say such a regulation has been found almost impossible to enforce, and at present no more can be done than reduce as much as possible the number of switches or movable contacts, and box them up away from access by the outer air.

One great difficulty and disadvantage to encounter in the installation of electric lighting on an oilfield, lies in the comparatively short existence of the latter as a local area of active work; and this applies still more to individual derricks or wells. Until the field engineer knows whether a new well is going to be productive, and on what scale, he can hardly be blamed for regarding its installation and equipment as very largely provisional and temporary. He may have to abandon the well at any time before or after reaching the oil stratum; why then instal an expensive and permanent electric lighting system? Herein lies a very important difference between oil boring and coal sinking. In the latter case the engineer knows exactly what he is going to get, and plans his installation accordingly, on complete up-to-date lines, to serve for years to come.

There is, however, far too much of the "temporary" element about oilfields electrical work, even after allowing for the likelihood of early changes; and whatever trouble has at any time occurred in this connection (and there has been such trouble) was practically due altogether to the use of work and material that sadly required Home Office and fire office rules and regulations for protecting life and property.

It is not right, for instance, that 500 volt 3 phase alternating current bare wires should be carried about and across an oilfield on the ordinary type of short wooden telegraph or telephone poles, even though the position and direction of these overhead mains may require constantly changing as the field develops; it should be quite easy to so design the system of supply that perfect safety may be secured with due economy in capital outlay or working expenses.

Probably much more care has been spent on the development of electric power in the oilfields, since there are in this direction serious competitors in the shape of steam and gas engines.

In the ordinary way, as has been pointed out on many occasions in these columns (see the Elec. Rev. 23rd December, 1910, p. 1042, and 6th January, 1911, p. 28), very great economy can be obtained by the use of electric power both in drilling and bailing, or pumping, as compared with steam engines drawing steam from boilers fired with oil fuel; and this saving will to-day be even greater owing to the much-increased value of crude oil, which renders its use as boiler fuel almost impossible.

Naturally, the figures of working cost are affected somewhat unfavourably towards electric power when the steam boilers can be fired as they now very often are by the oil gases emanating from the wells, and otherwise wasted on the field, where, as mentioned, they constitute a distinct source of danger. It is, however, necessary to have a large number of wells from which to draw gas in this way, otherwise the source of supply is too uncertain; besides which even the oil gases—being highly benzinous—are nowaday getting too valuable to burn as a fuel, since they should be capable of conversion into gasoline, or other forms of light spirit of great value in the market.

The chief advantage claimed by the advocates of steam power in oil derricks is, of course, the great elasticity of a steam engine, which fits it so well for the wide range of power required in drilling or bailing. The ordinary driller is quite satisfied and contented to use nothing but a roughly made high pressure single cylinder common or garden engine, leaking steam everywhere, and as full of rattle and bang as a donkey pump on a tramp steamer. What it costs to run in wasted steam—perhaps half a mile from the boiler—and repairs (necessary, but not always carried out) is no concern of his, so long as it does what he wants for the time being, and it is perfectly astounding what work these contraptions are capable of doing for so long under such exacting conditions.

The increasing use of rotary drilling, however, has called for a little more scientific exactitude, and the economy of working with electric motors is beginning to be more widely appreciated. At first, engineers made the natural and usual mistake of installing motors of too small a capacity for the work—contenting themselves with one of 30 H.P. where a 50 or 60 H.P. motor would have done the work far better and quicker, and with little more consumption of energy.

A speed reduction countershaft is necessary, but this is no great practical disadvantage, as it enables the motor to be fixed in a separate small fireproof brick building, covered with corrugated iron, and secured by lock and key from interference, away behind the derrick. Two slots in the wall allow the passage of a driving belt from the motor on to the countershaft, whence another belt is led to the drilling rig in the derrick.

Even in steady percussion drilling, where the ground is comparatively soft rock—shales, marls, or sands—the variation in power required is very great

from time to time, as the drilling bit, or the bailer, occasionally binds, or the casing sticks. An inrush of sand may take place, and the motor is suddenly called on for nearly double its normal load. The belt may slip enough to give it time to recover, but the work is hardly what one would choose for a 3-phase motor of this type.

There is probably a very large sphere of usefulness in all kinds of drilling work—whether percussion or rotary, and more especially with the latter, because of the more easy control of feeding the drill bit—for a more flexible and reliable intermediary gearing between the motor and the bit; a system, for instance, like that devised by Profesor Hele Shaw, and now offered by the Compayne Company, should have very great advantages in both systems of drilling. The electric motor can in this case be installed at a considerable distance from the derrick, out of range of any gas eruptions.

It drives direct an oil pump, forcing oil through two small bore copper pipes carried to an oil motor in the derrick, and this motor it is possible to regulate through a considerable range of speeds, at full power if necessary, by hand or even semi-automatic means.

So far as ordinary pumping is concerned, there is no difficulty in using an electric motor and countershaft, coupled up to a pumping rig with arms and chains, or wires, leading to the various derricks and wells to be pumped; and, as practically no attention or supervision is required, the plant may be left to run itself for as many hours each day as the oil can be pumped. Gas engines are also used for the same purpose, for which they are much better fitted than for drilling or bailing—as the load on a pumprig is very even where a number of wells are being pumped. In some cases, too, enough oil gas may be secured from one or more of the pumping wells to operate the engine, and in such instances the economy of working cost is hard to beat, as the engine fuel cost is practically nothing at all.

For the work of drilling and bailing, the gas-engine—although it has been used with fair success—is nothing like so handy or convenient, nor yet so elastic, as the electric motor, owing to the great variations in power required. Its first cost is also greater, being in proportion roughly about £400 as compared with £280 for steam engine and boiler, and £180 for a 30 H.P. electric motor with transmission gear, or £204 for a 50 H.P. motor and equipment.

Quoting the figures as to the working cost of electric motors from experience in the Roumanian oilfields, it may be estimated that in percussion drilling, from 90 to 120 KW.-hours per day are required, and for bailing a somewhat greater allowance—say, from 140 to 160 KW.-hours per day. Percussion drilling with water flush takes more power—from 180 to 250 KW.-hours per day; the figures for rotary drilling can hardly be given as yet, until more experience with these newer systems has been gained.

Current is provided for power purposes at 1.2 centime per KW.-hour. The price is calculated for a fuel cost at the power station equal to 35 frs. per ton, and for every franc rise or fall in the price of fuel at the power house, the price of energy rises or falls by one-tenth of a centime.

Assuming that a well is drilled for four months, and then bailed for eight months, and allowing for holidays and wasted time, the energy used for the well during the year would be 35,000 KW.-hrs., and the daily cost between 14 and 15 francs, or, allowing for repairs and maintenance of the electric equipment, the total cost should not exceed 15 frs. 50 c., equivalent to about 12s. 6d., which can hardly be called an excessive sum for cost of energy per day per well.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

As a result, probably, of the terrible disasters which occurred on the Great Lakes in the storm of last November, the Dominion Government has decided to install a large electrically operated fog-horn at Goderich, Ontario.

The Electric Power Company, which supplies current over a large area in Eastern Ontario, the power being chiefly generated on the Trent Canal and Trent River, is evidently following the example of the Hydro Electric Power Commission of Ontario, as it is stated that the services of its engineering staff are at the disposal of any municipality, presumably actual or prospective customers, considering lighting and power problems.

Montreal proposes to build a municipal electric plant of 10,000 H.P. capacity, and a loan of $2,000,000 has been authorized for this purpose.

On the French River, which runs from Lake Nipissing to Georgian Bay, a dam is to be built by the Department of Public Works in order to facilitate navigation, but advantage will be taken of the water power thus made available to generate electric current for lighting the navigable channels and supplying what power is required at the dam.

In the town of Sudbury, which lies just north of the mouth of the French River, it is proposed to add to the power plant.

The Montreal Tramways Co. has just built a car designed specially for carrying prisoners from the city out to the new prison seven miles away. Fifty-four passengers can be carried, and there are two separate compartments arranged so that the convicted persons can be kept apart from those not convicted.

The Public Utilities Commissioner of Winnipeg has submitted a report to the Government of Manitoba dealing with the question of generating and distributing hydro-electric power throughout the Province. A year or two ago there was talk of the possible formation of a Hydro-Electric Commission, on the lines of that already making such rapid progress in Ontario; apparently the report mentioned above is a sort of preliminary in order to ascertain whether it would be worth while taking up hydro-electric works in this manner.

The Commissioner bases his remarks largely on information which has recently been made available by the publication of a report on the water powers of Manitoba by the Water Power Board of the Department of the Interior at Ottawa. Although the report does not favour the immediate establishment of a provincially owned system and the building of many miles of high-tension transmission lines, it is by no means hostile to the idea. The chief difficulty, due largely to the scanty populations to be served, seems to be that of making such a scheme a financial success. In this view the Commissioner is no doubt correct as, although the provision of cheap electric power would certainly attract many industries and give rise to great increases in population, yet, even so, it would be many years before there could be any considerable number of inhabitants in Manitoba, and until such a time came it would be difficult to make a large hydro-electric scheme pay its way. Western towns, it is true, have a reputation and a capacity for growing apace, but where distances are so great and populations so small it is well to be cautious in considering great outlays of capital for ambitious enterprises.

To anyone at home, unfamiliar with Canada, Ontario, the most thickly populated Province of the Dominion, even in the south-western portion, which is the most densely inhabited section (if such terms as "thickly populated" and "densely inhabited" may be allowed), seems to contain an insignificant

number of people. The whole area of Ontario is about three and a-half times that of the British Isles, and its total population is a little over two and a-half million people, or rather more than one-third that of the whole of Canada. By far the greater number of these people live in the already mentioned south-western portion. Toronto, with nearly 500,000 citizens, is by far the largest city, others containing populations of 20,000, 30,000, or so, and the remainder consisting of little towns and villages.

Wireless telegraphic communication has just been established with Port Nelson, on Hudson Bay; by this means the men working out there will get the news of the outside world and life will undoubtedly be made much more pleasant. Looking at a map of Canada and comparing the centre of population, considered latitudinally, with the location of Port Nelson and Fort Churchill makes one think that the latter are in the regions of the Far North, and so far as temperatures are concerned they really are, yet Port Nelson is not much further north than Edinburgh. Probably the immense stretch of uninhabited and practically uninhabitable land covered with forests, with peat bogs of enormous extent, wild and uninviting and subject to temperatures of 40, 50 and more degrees below zero in winter, is responsible for the impression referred to. Port Nelson will be the terminus of the Hudson Bay Railway which is to give the western grain markets another outlet to Europe, and an engineer has recently gone to this place and Fort Churchill to plan out town sites for these two places which, if the anticipations as to the utility of the Hudson Bay route are realised, will no doubt become thriving towns soon after the railway is completed.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Lighting of the I.E.E. Theatre.

While I am in complete agreement with your remarks on the subject of the lighting of the I.E.E. theatre, I think you might also have added a few criticisms on the ventilation of the theatre.

There is a deadly stagnation about the air of the theatre which is most depressing. When the attendance is at all large, the heat and closeness towards the end of the proceedings is very trying. I may be told that the air is carefully filtered and warmed before it is passed into the theatre, but, speaking for myself, I should infinitely prefer a few open windows letting in the possibly impure, but, at least, fresh air, from the river, even if it involve some risk of draughts.

The atmosphere closely resembles that of the House of Commons, and it was admitted recently that the conditions there are adjusted to meet the requirements of somewhat elderly men.

Surely the average age of the Institution membership is sufficiently low to permit of the admission of a little fresh air without undue risk to health.

M. Farrer.

Twickenham, *March 26th*, 1914.

I have noted with interest, not unmixed with amusement, the correspondence evoked by the leaderette in your issue of the 20th inst. The implied condemnation of indirect lighting, as such, by Mr. Trotter, and the attack, by Mr. Broadbent, upon the use of "shadowless" lighting and the employment of the open-type arc lamp, are equally irrelevant and uncalled for.

The fact that the lighting of the theatre in question, largely by the indirect method, has to some extent failed to give continuous satisfaction in service, does not in any sense indicate that the system of indirect lighting, *per se*, is at fault, but merely that insufficient regard was paid to the fact that not only both the light sources used have a very high "ageing" coefficient, but that the initially high absorption of the mahogany panelling would increase materially with the passage of time, a lapse of quite an excusable character having regard to the knowledge of such factors available three or four years ago.

In citing the lighting of the Lecture Theatre at the Institution of Civil Engineers in support of his views, Mr. Trotter stands self-condemned. Reference was made to this installation at the last meeting of the Illuminating Engineering Society, when a photograph showing the artificial lighting was exhibited. It was then stated on behalf of Mr. Trotter that the system adopted was generally similar to that used in the theatre of the Electrical Engineers, that the average illumination in foot-candles was practically the same, but that in this case the proportion of the total illumination contributed by the direct lighting was so small as to be, for all practical purposes, non-existent, whereas in the case of the Electrical Institution Theatre, the proportion so contributed is just over 25 per cent. of the whole.

If, therefore, as Mr. Trotter states, the "general effect" of the lighting of the Civils' Theatre "is much better," and I and others who have seen it quite agree that it is, then it must be conceded that the improvement is undoubtedly attributable to the fact that the lighting is in this case *more indirect*.

Those harrowed by the contemplation of Mr. Trotter's pen picture of the "invalid wearying of slops, however nourishing, and longing for something to bite," may also turn with relief to the spectacle of the "Handy Man" who, after a spell afloat on hard biscuit, "plumps" on reaching port for a diet graphically described by him as "soft tack" or "mush."

Mr. Broadbent's views on the subject of "shadowless" lighting would be interesting, although not very enlightening, if such lighting, or anything approaching it, could be obtained in practice. As it cannot, and especially as it cannot by the use of arc lamps, and as, moreover, the bubble of "shadowless" lighting was pricked and effectively burst some three years ago, they are at this date irrelevant in the extreme, although not devoid of unconscious humour.

The "fallacy" of 20 years ago that the light from open type pure carbon arc lamps, or at all events from certain forms of such, is the nearest approach to daylight which is yet available for the purposes of general illumination has also, like many another supposed fallacy, since been conclusively proved to be true, and it is significant in the extreme that amongst those whom Mr. Broadbent so impolitely describes as "dupes," are numbered many of the most progressive and important firms and individuals in the business world of to-day.

That indirect lighting, and again in particular indirect lighting by arc lamps, is in many cases and for many purposes *more* rather than less efficient than other forms of lighting, is also now well known to, and freely admitted by, both illuminating and consulting engineers who have studied the subject, as well as by many rank and file users who, knowing nothing of the underlying scientific reasons, have by actual experience conclusively satisfied not only themselves, but their employés, that this is so.

May I also point out to Mr. Broadbent, and to those whom his statements may have misled, that where suitable arc lamps are used—and such are readily obtainable—the regular attention which must, perforce, be given to them, does away with the bulk of the losses in the resultant illumination due to the "ageing" of the light sources and the deposition of dust and dirt upon them, and/or the shades or reflectors when these are used, and leaves only to be reckoned with the fading or darkening of the surrounding walls and ceiling.

Carefully conducted experiments by impartial authorities have resulted in the determination of losses due to these causes of upwards of 40 per cent. in comparatively short periods in the case of certain light sources.

There are, on the other hand, many installations of arc lighting—and even of the type of arc lighting so despised by Mr. Broadbent—in which the falling-off in the illumination has not amounted to anything material, even after the lapse of several years. One such, using inverted arc lamps of a make which shall be nameless, was spoken of at the meeting of the Illuminating Engineering Society above referred to, by a leading Westminster consulting engineer, who stated that illumination measurements made by him after some two years' use of the premises—a large modern store—agreed within a very small margin indeed with those made when the lamps were first installed and the premises were new.

With such facts as these upon which to build up their constitution, indirect lighting and the pure carbon arc lamp can withstand with impunity both the kick which you, Sirs, are incorrectly alleged to have administered, and the more general if less scientific pummelling of your correspondents, and will continue in spite of all mis-statements to make more and more progress as their merits become more widely known.

Justus Eck.

London, *March 30th*, 1914.

I was interested in the discussion upon the lighting of the Institution theatre, interested because, as I see it, neither your good selves nor your correspondents fully grasped the intricacies of the problem. As it appears to me, there are many situations where the indirect light fitting, with its flat shadowless light, is not suitable, and where, apart from the decorative value of the fitting, the light itself must be considered, not so much from the efficiency as from the æsthetic standpoint.

For instance, I have seen it claimed that indirect lighting has been successfully applied to installations in churches. I should beg leave to doubt that unqualified statement. I would suggest that whereas such lighting might by some people be considered successful in the kind of meeting place which is, by courtesy, called a church, yet one feels that the beauty of our cathedrals, and of most of our churches, depends to no small extent upon the subtle and beautiful use of light, and the no less beautiful use of shadows with their mystery.

There is something here more than "foot-candles" and "lumens;" there is something metaphysical in the effect such shadows create upon the human mind, and not always the ignorant human mind.

In quite another connection the same considerations arise. I have heard lighting engineers discuss the unscientific lighting of certain restaurants, and other places of public resort. They evidently thought that, say, Frascati's would be improved by being illuminated with the flat shadowless light of the indirect system; I doubt whether they would enjoy the change. When one is sitting at a well-laid table in a public room, and the bubbles are rising in one's glass, and there are pretty faces and the glint of jewels to look upon, it is one's senses, and not one's sense, that make demands; and the designer and decorator of such places, if he knows his work, will continue to sin in point of efficiency in the same old way.

A more homely illustration is, perhaps, the ordinary dining-room fitting with a silk shade, brightly illuminating the table and diners, but leaving the rest of the room in shadow. The mere idea suggest comfort and pleasure.

I would suggest to the advocates of the new forms of lighting that it is possible to do their cause harm by undue insistence upon its merits. There are many positions where it is absolutely right, but there are more where it is absolutely wrong.

The world does not consist solely of insurance offices and lecture theatres, and although such delectable places are often perfectly illuminated by our lighting experts, one feels that even an illuminating engineer might object to living in them always.

T. Birkett,
Manager, Simplex Conduits, Ltd., Art Fittings Department.

Birmingham, *March 30th*, 1914.

Maintaining High Power Factor.

In reply to "R. E. M.'s" letter appearing in your issue of the 20th inst., I beg to submit the following:—

1. There is no hard and fast rule. As a rough rule, it may be said that when running off the mains of a supply company, the horse-power of a squirrel-cage motor which has to start on heavy load should not exceed 5 per cent. of the K.V.A. of the total minimum generating plant, or 10 per cent. if it starts on light load. On a large power system lower figures than the above would have to be taken. On a self-contained system such as a group of collieries with their own generating plant, these figures may be easily doubled. On the Continent in certain districts rigid laws exist forbidding the use of squirrel-cage motors above a certain size.

2. In most cases the station engineer will look after his own power factor by having an over-excited synchronous motor running in his own station.

3. "R. E. M." will find numerous examples in any good book on alternating currents.

4. *Proceedings* Institution Electrical Engineers, "Starting and Speed Control of Induction Motors," by F. C. Aldous.

John Barratt.

Middleton, *March 20th*, 1914.

Crane Motors at the County Hall.

We note in the current issue of your journal that there is an article on the "Electrical Power Applications in the Construction of the County Hall, Westminster," and whilst reference is made to Messrs. Siemens and the Lancashire Dynamo Co. as being makers of certain motors, no mention is made of the fact that we supplied the motors on all the Scotch cranes supplied by Messrs. Butters Bros. on this contract, these being the 20-H.P. motors referred to (see first column on page 541). We have supplied at least seven of these 20-H.P. motors for this contract, and in pointing this out we might remark that we have in many instances noticed in various technical journals, when describing electrical installations of this kind where our motors have been in use, that no mention has been made of our name, and we think it only due that we should have similar recognition as our competitors in such circumstances as these.

For **J. P. Hall & Co., Ltd.,**
A. G. Hall, *Director.*

Oldham, *March 30th*, 1914.

[We regret very much that due credit was not given to our correspondents for their share in this undertaking, regarding which we had no information. While we are not concerned with the failings of other journals, we always endeavour to ensure that justice shall be accorded in our pages to all who bear a share in any noteworthy undertaking.—Eds. Elec. Rev.]

Load, Strength, Stress and Strain.

The writer of the article under the above heading in your issue of March 27th has called attention to a source of confusion which undoubtedly exists. I am not sure, however, that he succeeds in making matters much clearer, nor do I find that his view as to the correct use of the term "stress" is the one which is generally supported by writers on mechanics.

Unless I misread his argument, his contention is that the only correct use of the term "stress" is its employment as synonymous with "unit stress," when it is measured in terms of lb. or tons per unit of section.

On referring to some half-dozen text-books on mechanics, taken at random from my shelves, I find that in every case, except one, stresses are taken as measurable in lb. or tons, and that a distinction is drawn between such stresses and "intensity of stress" or "unit stress" which can be measured in lb. or tons per square inch. The exception is, curiously enough, Prof. Perry's "Practical Mechanics," which states that "stress is the load per square inch," and proceeds, two or three pages later, to speak of the *stress per square inch*, a manifest "contradiction in terms" of his previous definition—a contradiction which may be noted also in the article in your columns (see third paragraph).

Surely we are so accustomed to speaking of "stress diagrams" and the calculation of the "stresses" in the members of structures, that we cannot limit ourselves to using "stress" in the sense suggested by your contributor. The term "strength" can just as easily be defined in terms of "tons per square inch" as in tons, whereas your contributor appears to limit the use of this term so as to make it synonymous with "total breaking load," and to exclude its meaning as defined by "breaking load per square inch of section."

In conclusion, I think that clearness is to be reached by indicating the units adopted when speaking of "stress," "strength," "load," &c., rather than by fixing an arbitrary meaning to these general terms, which is not universally accepted.

Charles F. Smith.

Leeds, *March 29th*, 1914.

Appointment of an Assistant Electrical Engineer.

I applied for, and received, a form of application for the above position, and I found one of the conditions of appointment (Item No. 10) read as follows:—No application will be considered unless the certificate at the end of this form is signed by the head of the department where the applicant is at present employed.

I wish to protest against the insertion of such a condition as this. How many of us would care to go to our chief engineer and ask him to sign a form of application for a berth elsewhere? In my own case, if I did such a thing I should be asked to resign, although I have many years of service to my credit. I think this is not only a hard condition but unreasonable, as I for one am barred because it would not be policy for me to let my employer know I thought of leaving, more especially as I consider my chances were good on account of having had Diesel experience, this station having Diesel engines.

Chief Assistant.

The Borough of Worthing recently advertised for a chief assistant electrical engineer, maximum salary £175 per annum; applications had to be made on a special form supplied by the borough. One of the conditions of the application was that "No application will be considered unless the certificate at the end of this form is signed by the head of the department where the applicant is at present employed." The certificate read as follows:—"I have perused the replies to the questions on this form and the information contained therein is correct." The questions on the form are rather more detailed than is customary; they relate to age, health, married or single, present and past employment, with dates, salary, &c., practical and theoretical training, with dates, examinations passed, degrees held, central station and mains experience with dates, all this to be certified as correct by the head of the department where the applicant is at present employed. In my opinion, no chief engineer could sign one of these forms conscientiously, and, again, it is grossly unfair to force all applicants for the position to inform their present chiefs that they are applying for another position; it is generally quite time enough to let them know when you have obtained the position. I cannot help thinking that the certificate is on the application form by an oversight. I know that a number of very efficient men have not been able to apply for the position owing to the fact that they did not think it advisable to get their chiefs to sign the certificate, and I believe in one or two cases chiefs have refused to sign on the plea that they could not guarantee the correctness of the replies to questions with regard to previous positions. I enclose a copy of the form in question.

W. J. Ebben,
Hon. Sec., A.E.S.E.

London, N.E., *March 31st*, 1914.

The Policy of the A.E.S.E.

The daily Press has recently informed the public at large that owing to the present wiremen's dispute London will probably be without its tramway, tube and electric light and power services. As some of the members of the A.E.S.E. are responsible for these services, the Executive Committee of the A.E.S.E. has requested me to contradict again emphatically the statement that the A.E.S.E. is involved in any way in the present dispute, or is connected with or co-operating with any Trade Union, and also to state that, as far as the A.E.S.E. is concerned, these services will not be affected.

The inference that has been drawn from these daily Press reports by a number of provincial members, prospective members and others, seems to be that the London members of the A.E.S.E. are about to strike, which is absurd. Anyone who knows the minds of the members of the present Executive Committee and the London District Committee (who are responsible for the conduct of the general business of the Association and the London district respectively), will realise the absurdity of the mere suggestion of a strike of A.E.S.E. members; in fact, the general body of the members as well as the members of the various committees of the A.E.S.E. I am convinced would not strike, as they are quite certain that they can better their general working conditions, salaries, &c., and, incidentally, raise their status by methods of a more peaceful character.

Recently the chief engineer of a large London supply authority expressed a wish to the writer that the A.E.S.E. would become of such standing that chief engineers requiring to fill vacancies in their stations could insist on having a member of the A.E.S.E., membership of the A.E.S.E. being the "hall-mark" of efficiency.

It is the aim of the present Executive Committee to endeavour to attain this high standing, at the same time using every effort to improve the general working conditions and salaries of all engineers in charge of electrical plant.

W. J. Ebben,
Hon. Secretary, A.E.S.E.

London, *March 31st*, 1914.

Railway Rates and Charges.

I shall be glad if you will kindly allow me to trespass a little on the space of the "Correspondence" columns of your valued paper, to call the attention of traders generally to the increases in the rates and charges at present being enforced by the various railway companies.

There is the 4 per cent. on all rates excepting class rates, straw, coal and coke, timber, and live stock. It cannot be admitted by any that the recent increase in wages paid by the companies amounts to anything like 4 per cent., and it is very singular that with one or two exceptions, every company shows such an increase in its returns just completed, as to warrant the payment of increased dividends; it is, therefore, apparent that a 2 per cent., or at the most a 2½ per cent., increase would be ample to meet the extra expenditure incurred; further, the companies are charging the 4 per cent. on the maximum fixed terminal and service charges, in addition to the actual conveyance rates, which is not legal.

Erroneous charges occur in many instances in charging goods in their wrong classes, and not in accordance with the railway classification and regulations, and errors in weight—charging 4-ton consignments at 2-ton rates, where no 4-ton rate is in operation, instead of getting a 4-ton rate fixed. As regards the classification at present in operation, the following are a few of the modifications which should be made:—

Castings, brass or light iron, should be Class 2.

Electroliers and electric fittings should be Class 3.

Calculating and cash registering machines in parts, packed, should be Class 3; fitted, packed, Class 4.

Tools, engineers', in cases, should be Class 2.

Tubes, brass or copper, packed, should be Class 2; not packed, Class 3.

Chemicals (not dangerous), in bags or bales, should be Class 1; in casks or iron drums, Class 2.

Paints in casks, drums or tins, packed in cases, should be Class 1.

Varnish in casks, drums or tins, packed in cases, should be Class 2.

The above are only a few instances which show how the friendly relations between buyer and seller may be upset through

railway carriage overcharges, as when a customer is charged an excessive rate repeat orders are rarely placed.

Traffic is conveyed by the particular company's own routes to whom it is first handed, whereby delays frequently arise, together with late arrivals for markets, &c., claims resulting being inevitably refused by the companies, when, if submitted in accordance with law of carriage, they would have to be admitted. Shorter routes exist in the majority of cases, and if goods were fully and properly consigned, they would receive much quicker transit.

Then there is the very important question of rebates, to which traders are entitled in many cases, *i.e.*, private sidings, loading and unloading of goods, cartage and delivery, returned empties, &c., these allowances being lost by traders through their ignorance of railway matters and not availing themselves of the services of fully qualified railway specialists in the handling of their railway and shipping business. Many rates are excessive, not being based on the shortest mileages or rates from other stations taken in comparison.

The charges for demurrage should not be raised—this would not, in many cases, be necessary if traders were allowed four days instead of the two days, as at present, for unloading traffic, and if then incurred should be at the rate of 6d. per truck per day, and not 1s. 6d. and 3d. per sheet per day, as is now enforced.

What is necessary, undoubtedly, is a strong Railway and Shipping Traders' Protection Association, and those interested are cordially invited to communicate with me, when I shall be pleased to render any assistance in my power.

J. E. Thompson, F.C.I.

86, May Lane, King's Heath, Birmingham,
March 28th, 1914.

LEGAL.

War Office *v.* Kirkland & Capper, and J. H. T. Woodd.

(*Continued from page* 542.)

The Solicitor-General, continuing his opening statement in great detail, said that by Clause 13 of the War Office specification, it was provided that the conductors were in all cases to be accessible to authorised persons, they were to be enclosed in casing or conduit, carried on cleats, or to be lead-covered. It was provided that a particular sort of conduit, namely, "barrel," was to be employed for the protection of conductors when buried below plaster or in concrete work, and that lead-covered conductors might be used in any situation, provided the conductors were accessible, and might be run through walls or partitions, or under plaster for short lengths, *e.g.*, behind cornices or mouldings. It was also provided that in order to comply with the condition as to accessibility the lead-covered conductors might require to be drawn into conduit or otherwise protected. Lead-covered conductors where liable to mechanical injury were to be drawn into conduit. It was complained that Kirkland & Capper negligently allowed the contractors to employ lead-covered conductors buried in the plaster without conduits and without any strong covering or protection of sufficient strength to resist a nail, or any sufficient protection at all, and to carry the conductors over rough walling and rough corners, so that the lead covering became broken. It was also said that the defendants, Kirkland & Capper, negligently allowed the contractors to lay the lead-covered conductors in an irregular way so that the defendants did not have any record of the places where they were laid. So complete was the failure of the installation, that the War Office had to renew the wiring over the whole building, Messrs. Foote & Milne, electricians, being paid about £1,400 for the work.

Sir Stanley Buckmaster, dealing with the defences, said that in answer to certain interrogatories as to the terms upon which they were engaged, the defendants had stated:—Answer of Mr. Woodd: The plaintiff, through me, appointed Messrs. Kirkland and Capper as experts to prepare plans for and to supervise the electrical engineering and lighting work for a payment based on the cost of work carried out under their supervision. Their payment was to be at the usual rate of 5 per cent., and in accordance with a then standing agreement between myself and Messrs. Kirkland and Capper, 1 per cent. out of this 5 per cent. was to be paid by them to me for services to be rendered by me to Messrs. Kirkland and Capper in connection with the work, for which I should not have been entitled to charge, and did not charge, the plaintiffs. I do not myself recollect what was said as to which of us was, or were, to be responsible to the plaintiffs, but it was common ground between us that Messrs. Kirkland & Capper would be. The answer of Kirkland & Capper was as follows: The plaintiff, through the defendant Woodd, appointed Messrs. Kirkland & Capper to prepare plans for and to supervise the electrical engineering and lighting work for a payment based on the cost of work carried out under their supervision. This payment was to be at the usual rate of 5 per cent., and in accordance with a then standing agreement between Mr. Woodd and Messrs. Kirkland & Capper, 1 per cent. out of that 5 per cent. was to be paid by them to the defendant Woodd for services to be rendered by the defendant Woodd to Messrs. Kirkland & Capper in connection with the works for which the defendant Woodd would not be entitled to charge, and did not charge, the plaintiff. The defendants, Kirkland and Capper, were to act as responsible experts. So far as the defendants, Kirkland & Capper, recollect, no further terms were agreed, and in particular nothing was said as to the responsibility of the defendant Woodd.

The Solicitor-General said that the installation was such a failure that he would show that at an important function soon after the opening of the establishment the whole place was plunged into darkness. There was an inspection in March, 1909, by the Westminster Electricity Supply Corporation, who found that there were serious defects. The Solicitor-General said that a War Office electrical engineer, named Mr. Allan Kirk, had inspected the electric installation at the place and had reported as follows regarding the section comprising C.O.'s quarters and officers' mess at the Royal Army Medical College, Millbank, S.W.:—

"The electrical supply is obtained from the Westminster Electric Supply Corporation on the three-wire system (continuous-current) having a pressure of 400 volts between the outers. The three-wire supply is divided at the main switches to give two supplies at 200 volts with a meter on each side controlling two equal installations, each wired on to the two-wired looped distribution board system.

"The whole of the circuit wiring has been carried out with twin lead-covered V.I.R. wires buried in the plaster. This system, unless very carefully installed, invariably breaks down due to the lead covering being damaged by 'kinking' or abrasions, and in any building where there is a possibility of nails being driven into the plaster the system becomes dangerous. In the present instance the workmanship appears to have been defective, the reasons for this statement being that on one piece of wire being taken out the lead covering had evidently been torn against a sharp edge of the brickwork whilst being installed, the rubber insulation had broken down and the wires were fused; further, the lead covering and tape on all the wires where attached to boards, fittings, &c., have been carelessly trimmed back, and no attempt seems to have been made to connect the wires up in their proper order, even the sub-mains in one instance having been wrongly connected. The defects are not merely isolated cases, but are general over the whole installation, due to the fracture in the first instance of the lead covering and contingently to the failure of the rubber insulation.

"In a twin lead-covered system, assuming that the lead covering is intact throughout and that the rubber insulation is perfect, no electrolytic or chemical action will occur, and there is no proved instance of lead being attacked by plaster or its components, so far as I am aware.

"The distribution boards appear to be of inferior make and poor insulating qualities; the latter defect is probably due to metallic veins in the insulating bases and lack of efficient bushing pieces.

"The flexible wires throughout are in poor condition, the vulcanised rubber having perished and cracked in many places; the practice of knotting the flexible wires inside the ceiling roses to act as cord grips, which has been resorted to, is very unsatisfactory.

"There is an entire absence of labels, lists, or other means of identifying the lights controlled by the various fuses, or any of the main or sub-distribution boards."

The Solicitor-General went on to refer to correspondence that took place when the matter got into the solicitor's hands. The Solicitor-General said there was a letter on behalf of Kirkland and Capper, in which (he alleged) there was no denial of the use of the lead-covered wiring that the War Office said caused the breakdown of the system, but which suggested that the lead wiring system was introduced at the instance of Woodd. In effect, the letter said "it was Woodd who made us do what we did, and it is on Woodd that the responsibility must rest." Their use of the lead wiring they did not appear to challenge, but they only said it was a question as between themselves and Woodd which of the two was liable.

In reply to a comment by Mr. Walter, K.C., the Solicitor-General said with emphasis: "What we say is perfectly clear. We say that there was negligence in permitting lead wiring to be used, and that the use of that wiring caused the breakdown of the whole system." The Solicitor-General went on to say that Mr. Woodd was asked to explain why—contrary to the contract—he allowed the lead-covered wiring to be buried in plaster, and a reply was received, but he declined to accept full responsibility. There was no serious attempt to contest the allegation that the use of this particular form of conductor caused great mischief, but what was disputed was liability. Mr. Woodd had the superintendence in general terms of the lighting, although the actual work was given out to experts, but if Woodd directed the use of a system contrary to the builders' contract it was a breach of his duty as an architect. Messrs. Kirkland & Capper were employed by the War Office to see that the work was carried out according to the specifications, and that they clearly did not do, because they permitted the wires to be placed in a manner that the specifications prohibited. The question, therefore, was, did this system of wiring cause the mischief complained of?—and counsel thought there could be only one answer to that question.

The other side said the test the War Office had made was unsatisfactory as it tested the fittings, but he would point out to the Court that when the final test was effected they tested nothing but the

wires. They got rid of all the fittings and took the naked wires from the lead covers, and tested them in each case, so that when the test was made in July, 1910, the failures, however they might be explained, were due to failures in the lead-covered circuits. Mr. Woodd disclaimed all responsibility, and said the work was executed by contractors appointed by the War Office under a contract that he had never seen. He added: "It was tested and approved not only by the experts employed to superintend its execution (under Clause 14 of my conditions of employment as architect for these buildings), but also by a representative of the War Department who declared the installation to be satisfactory in June, 1908, more than a year after the buildings and installation had been taken over for occupation." It was pleaded in defence also that there was negligent user of the installation, and the particulars of negligent user said fuses were removed and copper wire substituted. This would involve that you placed in a fuse box a piece of wire that could stand a much stronger electric current than the fuse wire that had been taken away. That meant you might transmit into your circuit a stronger current than would otherwise be there, but that would not in any way affect the stability of the circuit if the circuit were properly laid and properly protected. The next thing is this: "The fittings were altered in position and refixed in a clumsy unworkmanlike manner and unsafe manner." That does not affect the circuits tested in the way in which these circuits were tested in January, 1910. "The distribution boards were not kept clean," is one observation applied to them.

The Solicitor-General then proceeded to call expert evidence in support of the case for the War Office.

Mr. Allan Kirk, A.M.I.E.E., said he had had 25 years' experience in electrical work, and was now in the service of the War Department. Before entering that he had 16 years in private practice. He had tested many installations. With regard to the use of insulated wiring covered by lead, he had examined installations where that system had been adopted. It was not usual to adopt that system where it was necessary to lay the conductors behind plaster, as it was impossible to lay it in plaster without faults occurring. He had examined some 5,000 installations, and in about the five cases only where this system was employed he found it had broken down. In February, 1909, he inspected this particular installation, and made the report that had been referred to. He found nothing wrong till he came to the sub-fuse boxes; at the latter he made tests to see if the circuits were in order, and the failures were discovered. They were due to the use of lead-covered wires buried in plaster without any protection. He thought alterations made by the Royal Engineers might have affected five circuits only. The failure to keep the distribution boards clean could not account for the defects that he found. The cost of wiring with lead-covered conductors put into the plaster as here was less than that of wiring through properly screwed or protected conduits. He reckoned the difference in the cost of the two systems for the work here was £268 17s. 8d.

Witness expressed the opinion that except for the danger of external injury, lead in plaster would be safe if it could be laid without injury, but his view was that this could not be done. He had heard that at Guy's Hospital they had a twin lead-covered system, and he would like to be able to inspect it.

He added, that the plaster in the majority of places put on top of the Frazzi blocks was deep enough to bury a ⅝th barrel pipe. He believed that substantially the floors and ceilings of all the storeys were made of Frazzi blocks. The fact that on the ground floor alone of the laboratory there were 202 pendant lights that all came through Frazzi blocks was quite immaterial.

Replying to Mr. Walter, K.C., Mr. Kirk said that he had been with various electrical firms. He was supervising foreman for Smeaton & Page, and had done practical work. There certainly were faults between the sub-boards and the connector-boxes that were apart from cases where the Royal Engineers had put in new meters. He was not prepared to agree with counsel's suggestion that every defect in the installation arose where the Royal Engineers had tampered with the work. He was not cognisant of his own personal knowledge of the alterations that were made by the Royal Engineers.

Mr. Walter, during the cross-examination, remarked that he had never heard of a more disgraceful usage than this electrical installation had been subjected to.

Re-examined by the Solicitor-General, Witness said the main defects were not discovered between the sub-fuse boxes and the connecting boxes, but between the connecting boxes and the lights. He could not explain that; it was a matter of luck. He denied that any of the defects were resultant upon any alterations effected by him.

Mr. William Henry Patchell, M.I.E.E., was the next witness. He said he was called in with regard to the present matter about a year ago, and on various occasions he made inspections of this electrical installation. He understood that it was in April, 1911, that Messrs. Foote & Milne had completed their work under the new contract. He only heard of the old installation in March, 1913. He had examined a number of specimens of the lead-covered wire and other things taken from the buildings, and he had read the specifications and the material documents in the case. To run lead-covered wires buried in plaster was a dangerous thing; the risks were too great. The Institution rules prohibited it. There might be mechanical damage by the plasterers; there was also the danger of anybody driving a nail into the wall. The danger of damage through leakage, in his opinion, was perhaps the most important risk. It arose primarily through bad work. The whole system must be made watertight and continuous, and it was very difficult, even when one was standing over the workmen all the time, to ensure that.

Mr. Gordon Hewart: It is said that where Frazzi blocks are used in the building, it is impracticable, or very difficult, to use wires in conduit. What do you say to that?—Frazzi blocks can be, and have been, cut, and in places that I saw in this particular building there was depth enough to put the conduit in the plaster without cutting them.

Taking the diameter of the barrel conduit itself, what is that?—Five-eighths.

For that you would need how much plaster?—If it was a job that had to be highly decorated, and you did not wish any appearance of the wires to show in the plaster, I do not think it would be safe to leave anything less than a quarter.

If you have the total of seven-eighths of an inch of plaster, or something more than that, that would suffice?—Yes.

Is that an unusual quantity of plaster to have upon a Frazzi block?—No; they had $\frac{1}{16}$ in this particular one.

Witness agreed with Mr. Kirk that these blocks could be chased even after they had been built in. He saw no reason why barrel conduit could not be employed.

Witness, in further evidence, produced calculations to show that the method adopted was cheaper than that that the War Office said should be adopted. He estimated the difference in the cost at about £213 10s. He examined specimens of lead-covered wires that had been cut out, and pointed out to Mr. Justice Lawrence the various defects in them.

(*To be continued.*)

Cross Claim for Damages.

In the King's Bench Division on Tuesday, March 31st, Mr. Justice Rowlatt heard cross actions between the Kidderminster and Stourport Electric Tramways, Ltd., and Messrs. Woodward Grosvenor and Co., Ltd., a firm of Kidderminster carpet manufacturers, in which damages were claimed on both sides: in the one case for injury to the tramway, and in the other for damage to a private electric cable.

Mr. Duke, K.C., with whom was Mr. Eustace Mills, in opening the case for the Tramway Co., said that as the actions both arose out of the same matter it might be convenient that the evidence taken in one case might be regarded as applying to both.

Mr. Hugo Young, K.C., for the defendants in the first action (Messrs. Woodward, Grosvenor & Co.), suggested that both actions should be tried together.

Mr. Duke, however, did not agree, and continuing his opening, said that the plaintiffs were the proprietors, under statutory powers, of an electric tramway at Kidderminster and the defendants were a well-known firm of carpet manufacturers in the same district, where they had several establishments, and the action was brought in respect of interference by them with the plaintiffs' tramway by tunnelling under it for the purpose of laying private cables to connect the lighting of their different premises. Those premises were separated by one or two streets, and the tramway ran along one of those streets. The question was whether the defendants had any right to tunnel under the tramway for the purpose of laying their cable. If they had any right, then the question arose as to whether they had exercised that right with reasonable care, having regard to the interests of the Tramway Co., and, if not, what damages they ought to be made to pay.

His Lordship: Do you bring your action for damage to the tramway? What is the action against you for?

Mr. Duke: We claim against them for damage to the tramway and they claim against us for cutting one of their cables.

Continuing, Counsel said that the defendants' cable being laid in the soil, the only means of getting at it would be by breaking up the tramway. He did not think any question arose as to the plaintiffs' rights to maintain the tramway, without interference by other persons, in a manner which might increase the cost or give rise to risks to themselves or to their passengers. The *locus in quo* was a street called Oxford Street, alongside an ancient highway known as Wolster Street. Oxford Street was constructed upon artificially-made ground, and the line of the two cables ran across the junction of Oxford Street and Wolster Street. What the defendants had been doing was to carry a cable from a point in Green Street under the paving of Oxford Street, and the tramway was interfered with in two places where the cable crossed. In July of last year the defendants gave the plaintiffs notice of their intention to open the street for the purpose of laying an electric power main. That notice appeared to have been given in the belief that they had statutory powers, but that did not seem to be the fact, and the plaintiffs obtained an injunction restraining defendants from interfering with the tramway. Subsequently, upon an application to continue the injunction till the trial, an undertaking was given by the defendants that they would not interfere with the work. On September 2nd the defendants proceeded to sink pits on either side of the road with a view to tunneling under the roadway. The tunnel was completed, and it came within 18 in. of the actual structure upon which the tramway rested. There had been a good deal of conflict about the making of that tunnel, and between the 2nd and 16th, it was found that the surface of the tramway below the rails had subsided appreciably. The plaintiffs' surveyors found it necessary to take up the roadway, when they found that the concrete foundation had been fractured from the point where the tunnel had been made. The cost of repairs was not a serious one, but the principle involved was a more important matter. The expense of making good the tramway subsidence would be about £29 or £30, and the making good the tramway itself for a distance of 20 yards would be about £60. The main

question was whether anyone was at liberty to dig a pit and drive a tunnel under the road.

Mr. Arthur Charlton, the first witness called, said that until recently he was managing engineer to the Tramway Co., a position which he had occupied for eight years. He was, and is, engaged in reorganising a tramway system at Sheerness. During the whole time he was with the plaintiff company it was part of his duty to superintend the permanent way, the construction of which he described in detail.

(To be continued.)

Crompton & Co., Ltd.

In the Court of Appeal, before the Master of the Rolls, Lord Justice Buckley and Mr. Justice Channell, on March 26th, Mr. Wright applied that an appeal which had been entered in *re* Crompton & Co., Ltd., from a decision of Mr. Justice Warrington, appointing a Receiver on behalf of debenture-holders of the company, might stand over until next sittings. Counsel stated that the learned judge had suspended the operation of his order until April 6th. The trust deed provided that the security should become enforceable if there was a winding-up otherwise than for the purposes of reconstruction. There had been a winding-up for the purposes of reconstruction, but Mr. Justice Warrington had held that the security had become enforceable, and an appeal had been entered from that decision. A scheme of reconstruction had been formulated under Sec. 120 of the Act, which scheme had been sanctioned by large majorities at the first meeting, and the confirmatory meeting had been fixed to be held next Tuesday week. In the circumstances, the learned counsel asked that the appeal should be ordered to stand over until after that meeting was held.

The Master of the Rolls stated that the application would be granted, as, having regard to the work which the Court had pledged itself to hear before the sittings ended, no interlocutory appeals from the Chancery Division would be heard before Easter.

Edwards *v.* Brixham Gas Co.

Nuisance from Electric Light Plant.

Application was made to Mr. Justice Astbury (for Mr. Justice Neville) in this action for the extension of the suspension of the operation of an injunction granted on December 17th to restrain an alleged nuisance of noise and vibration arising from the working of the defendants' electric light plant.

At the trial of the action, which took place in December last, the plaintiff, who was the owner of a shop and some cottage property at Brixham in the neighbourhood of the defendants' works, claimed relief in respect of damage to his property caused by defendants' recently-installed electric light plant. The defendants denied the nuisance and pleaded statutory obligations, and in granting the plaintiff an injunction his Lordship suspended its operation for three months to enable the company to alter their plant so as to abate the nuisance. That suspension had been continued by agreement from March 17th, and Mr. Gover, on behalf of the company, now applied for a further three months' suspension. This, he understood, the plaintiff would not object to on certain terms.

Mr. Peterson, K.C., who represented the plaintiff, said that was so. Two of the plaintiff's cottages, owing to what had taken place, there had been a great deal of difficulty in letting, and he asked that the defendants should pay as rent for them 3s. a week for each cottage as from March 17th. A further term he desired to impose was that the defendants should not use as evidence the result of any experiment they might make in those cottages, unless they gave the plaintiff or his advisers three days' notice of their intention to make the experiment and an opportunity to the plaintiff to attend.

Mr. Gover accepted those conditions, and his Lordship stayed the operation of the injunction until June 17th, accordingly.

Workmen's Compensation Claim.

Judge Mellor, K.C., sitting in the Manchester County Court on Monday, delivered his reserved decision in a case under the Workmen's Compensation Act, in which Samuel Robert Hart, of James Street, Openshaw, claimed compensation from Messrs. Vaughan and Son, Ltd., electrical crane makers, of West Gorton. The claimant's case was that on January 22nd he ascended a gallery to remove some rope blocks. In doing this he placed one hand on a rail along which a travelling crane ran. The crane started to move and he lost two fingers. The defence was that the accident did not arise out of, and in the course of, the man's occupation, and that Hart, by doing as he did, incurred a risk not incidental to his employment for which the employers were not liable. Judge Mellor held that although it was the claimant's duty to remove the rope blocks, he had incurred unnecessary risk in ascending the gallery and placing his hand on the rail, instead of climbing a ladder which had been used by a fellow workman for a similar purpose. Such a risk was not in the contemplation of either party at the time the workman was engaged. In his opinion, the accident did not arise either out of or in the course of the employment, and therefore there must be an award for the respondents.

OUR LEGAL QUERY COLUMN.

[Questions addressed to this column should be written on one side of the paper only.]

Company" asks:—"Has an urban authority power to compel a supply undertaking working under Parliamentary powers to lay all future cables in the roadways, when most of the original cables were laid under the pavement?"

*** The question is one of first impression, as it does not appear to be expressly provided for in the Electric Lighting Acts. By Clause 14 (1) of the Schedule to the Electric Lighting (Clauses) Act, 1899, it is provided that where the exercise of any of the powers of the undertakers in relation to the execution of any works will involve the placing of any works in, under, along or across any street or public bridge, notice must be given to the local authority, together with a plan of the proposed works showing the mode and position in which the works are intended to be executed, and the manner in which it is intended that the street is to be interfered with. The local authority may, at discretion, approve any such works or plan, subject to such amendments or conditions as may seem fit, or may disapprove them. There is an appeal from the approval or disapproval of the local authority to the Board of Trade. It would seem to be very unreasonable of the local authority in question suddenly to change their policy, but there is no case which shows that their discretion in the matter can be in any way controlled.

THE ELECTRICAL TRADES BENEVOLENT INSTITUTION.

On Wednesday last week the Festival Dinner of the Institution was held at the Trocadero. Mr. Hugo Hirst was the president of the evening, and there was a record attendance, one hundred and sixty-two guests sitting down to dinner, whilst a considerable number, who had taken tickets but were prevented from attending, sent messages of regret. The president was supported by Sir David Salomons (president of the Institution), Mr. Justus Eck (chairman of committee), Mr. C. H. Wordingham (vice-president), Mr. George Sutton, Mr. E. Garcke, Capt. H. Riall Sankey, Mr. Ll. Preece, Mr. M. Railing, Mr. L. G. Byng, and many other prominent engineers and supporters of the Institution.

After the toast of "The King," Mr. Hirst communicated the regret of many sympathisers at their absence from the table, including Mr. Cutler (president of the Garrick Dramatic Society), Baron Erlanger, Messrs. Ferranti, Hadfield, Koettgen, Touche, and Walters, and others, all of whom had intended to be present. He said that he had been collecting for a deserving cause, which had been too much neglected in the past. Electrical people were so much engrossed in their work that they were impervious to what was going on around them. Others, equally deserving, but less fortunate, had just failed to achieve success, and had gone down to a depth from which it was difficult to rise again. They were apt to blame a man for failure, but most of them had realised that, apart from ill-health, the electrical industry offered more chances for failure than any other industry—they had had to run great risks. Others had run the same risks and had failed, and they must sympathise with these. They all knew of such cases amongst their own friends. Poor men had the right to solicit favours and to ask for support, and society had organised relief for such cases; but those who were formerly their equals could not do so, and therefore they were organising a fund for their benefit. On their behalf his sympathies had been enlisted; it was not too pleasurable work, but it was worth doing. He expressed his appreciation of those who had come forward whole-heartedly in response to his application. There were others who would do so if the committee would take note of their criticisms. Amongst the former class he thanked the electrical and the daily Press. Next Mr. Garcke, one of those who came forward last year to support a proposal of Mr. Byng, who offered to give £100 if nine others would do the same. Unfortunately sufficient support was not given to that proposal, but Mr. Garcke gave his £100 all the same. Thanks were due to Mr. Hirst's own staff for their energetic support; they had applied to many people connected only indirectly with the electrical industry, who had contributed handsomely. As regarded electrical firms, he had received a number of interesting letters. Some were very flattering, and sent cheques through him, or through the usual channels, but some asked for whose benefit this fund was formed; it could not be too widely known that it was for anybody who was working, or had ever worked, for the electrical industry in any capacity. Others said that there was an undue relation between the expenditure and the benefits given; but this must always be the case when starting a new organisation. Others again said that the electrical industry had enjoyed a period of great prosperity—why should they beg at this time? The obvious reply was that that was the right time to provide against bad times. A great many large concerns and municipalities said that they had no funds for such a purpose, or had their own sick funds; but they must remember that men changed their

employment and moved from one situation to another; why should such men, if they fell ill or into trouble, not have a call upon those who could afford to help them? He suggested that, if possible, the committee in future elections should put on their list representatives of institutions, prominent firms and undertakings as members of the council, and make it clear to them that the fund was at the service of their employés; by this means it would be possible to extract regular subscriptions from them and build up an annual income. Until this came about, they would have to go on as they started.

Sir David Salomons, in supporting the toast, thanked the members for electing him president, and recalled that thirty years ago he brought forward the proposal to found a Benevolent Fund for the Institution of Electrical Engineers, which had thriven to that day. As president, he followed his great friend, the late Sir William Preece, who supported his proposal to change the name of the Society of Telegraph Engineers to its present form. Thirty years further back still, when Faraday announced the discovery of electromagnetic induction, a lady asked him of what use it was. The great inventor replied: "Of what use are babies?" Faraday was a true prophet, for the infant discovery had extended its influence to almost all industries. He wished prosperity to the fund, and hoped that its members would never have occasion to call upon it.

Mr. Wordingham, also supporting the toast, said he had stopped subscribing on principle, but now came forward as an enthusiastic convert to the scheme. He was averse to the multiplication of organisations, which caused inefficiency and waste; but there was an unanswerable reason for the existence of this fund, namely, that the I.E.E. fund was for the benefit of members of that Institution only, while this was for the vastly larger class who could not be assisted by the former. Some might urge that the Insurance Act did away with the necessity for this fund, but there were many who could not benefit by that Act. Their fund was not giving much at present in comparison with the cost of giving it; but the electrical industry and the fund were both very young, and organisations of this kind could not do much good until they had large sums invested, so that they could give out of income, not out of capital.

In the absence of Mr. Faithful Begg, Mr. Godfrey Isaacs supported the appeal, saying that it was the duty of every industry to create an institution of this kind. They should associate with their fund a lesson in thrift, by asking those who were provided for to subscribe towards the fund. He was a member of a company employing a large number of men, which had made provision at the rate of £5,000 a year to assist those who would benefit by their fund, but made the latter contribute one-half of the income. They would substantially support any institution of this nature.

Mr. Eck proposed the health of the president of the evening, to whom he expressed their thanks not only for presiding at the dinner, but also for his ceaseless industry on behalf of the Institution; from the beginning they had had the benefit of Mr. Hirst's advice and practical aid, and he had aroused the sympathy of his partners. His late partner, Mr. Gustav Byng, left the first legacy to the Institution, and Mr. Byng's sons had also supported them in a whole-hearted manner. As the result of Mr. E. Byng's suggestion at the last festival, not only Mr. Garcke, but also Mr. Dane Sinclair had presented £100, and other contributions had followed. There was a record attendance that night, and he expected another record when the President announced the result of the collection, leading him to hope that their ideal of £20,000 a year as well as a well-endowed orphanage was not beyond the reach of probability. He had watched the steady progress of Mr. Hirst, under whose hand new industries were always developing, and he cordially submitted the toast, which was accorded musical honours.

In reply, Mr. Hirst expressed his gratitude to his supporters, and said he was particularly glad to see Mr. Godfrey Isaacs amongst them. The result of the collection in connection with the dinner was £2,762, but this was not quite the total, as there were some important subscriptions to be added.

An excellent musical programme was provided, the artistes being Mr. E. Beaumont, Miss V. Oppenshaw, Mr. G. Blackmore, Mr. T. E. Gatehouse, Miss Renée Haslam and Mr. Fred Rome. Mr. Bernard Flanders was at the piano.

Electrical Steam Generation.—A recent issue of the *Journal of Electricity, Power and Gas* refers to the use of hydro-electric energy for steam generation, which is to be tried in Eastern Canada, where two 750-KW. 2,400-volt three-phase boilers, to produce steam at 125 lb. pressure for heating, &c., are being installed in a cotton mill. Our contemporary refers to numerous plants of a similar kind which have been in operation in Europe. The 750-KW. unit is 6½ ft. in diameter and 11 ft. high; the builders estimate that 1 KW.-hour produces about 3 lb. of dry saturated steam at commercial pressures up to 125 lb. The internal arrangement of the boiler apparently consists of groups of electrodes in non-conducting tubular structures, which take in water at one end and discharge steam at the other, the water forming the resistance. The electrodes are movable, and are switched on in groups, giving the necessary control over the steam raising.

BUSINESS NOTES.

Fittings for His Majesty.—Messrs. Escare and Denelle, Ltd., of 129, Wardour Street, W., have recently been honoured with the Royal Warrant of Appointment as Manufacturers of Electrical Fittings and Bronzes to His Majesty King George V.

Wholesale Traders' Association.—The Wholesale Traders' Association held its annual meeting on March 19th at the registered offices, 26, Corporation Street, Birmingham. We have received from the secretary, Mr. G. G. Poppleton, a copy of the annual report for the year ended at September last, in which it is stated that the Association had a very satisfactory year in all departments; 233 new subscribers were enrolled, making the number on the register 2,630. The status inquiries received numbered 117,097, this department being very largely made use of. It is suggested that "long firm" frauds could in most instances be checked in their earlier stages if victims would at once lay the circumstances before the Association and co-operate with its officers in bringing the offenders to justice; 32,957 debts were placed in the Association's hands to collect, and out of £286,298, £175,837 was recovered without legal proceedings. A speciality is made of the collection of debts in Scotland, Ireland and abroad. Other matters touched upon in the report are the New Bankruptcy Bill and Deeds of Arrangement, the law's delays, railway rates, and the insolvency department. The Association, which has an Electrical Trades Section, has offices at Birmingham, London, and Sheffield.

Catalogues and Lists.—Messrs. Crompton & Co., Ltd., Chelmsford.—Advance copy of a pamphlet (8 pp.) No. 536, giving a general description, fully illustrated, of their searchlight projectors, commercial and military patterns.

Messrs. L. Gardner & Sons, Ltd., 87, Queen Victoria Street, London, E.C.—Small pamphlet, intended merely as an illustrated index to the various types of vertical gas and oil engines, &c., manufactured by them.

Trafford Park Estates, Ltd., Manchester.—A 56-page booklet concerning Trafford Park, its situation, advantages, works and industries. Many photographic pictures and a coloured map showing the location of different factories, are included. The publication should be studied by anybody interested in the building of new works or thinking of removing from one centre to another.

Messrs. Balcke & Co., Ltd., Broadway Court, Broadway, London, S.W.—New 16-page catalogue No. 311, containing a full and well-illustrated description of their patent dry-air filters. We understand that they have now supplied and on order in this country, dry air filters dealing with a total of nearly 80 million cb. ft. of air per hour. Two of the plants are each dealing with not less than 7½ million cb. ft. per hour.

The Hagen Accumulator Works, 15, Holborn Viaduct, London, E.C.—Sixteen-page illustrated price list of their Hagen accumulators for various purposes.

Messrs. Ozonair, Ltd., 96, Victoria Street, London, S.W.—New Catalogue, No. 1, of 16 pages describing and giving illustrations and prices of Ozonair machines of various types and sizes suitable for dealing with air in private rooms and offices, cold stores, hospitals, cinemas, factories, &c. In several of the older patterns improvements have been made and new patterns of portable and semi-portable apparatus are included. For the convenience of retailers the first page of the list is detachable.

Messrs. Scholey & Co., Ltd., 151, Queen Victoria Street, London, E.C.—The March number of *Scholey's Magazine* contains a photograph and notice of Mr. J. F. C. Snell, descriptive notes on the Graham automatic electric lift, an illustrated description of the Frantz electric suction cleaner, a quarterly price list of various electrical materials, and some comments on the "British Electrical Manufacturer in the World's Markets."

Messrs. Reavell & Co., Ltd., Ranelagh Works, Ipswich.—New catalogue (TS 1) of 20 pages containing fully illustrated particulars of their three-stage compressors for use with Diesel engines, semi-Diesel engines, and the auxiliary work in connection with land and sea Diesel installations.

Messrs. S. H. Heywood & Co., Ltd., Reddish, near Stockport.—36-page catalogue containing a large collection of illustrations of their electric transporters, pulley blocks, and runways of various capacities in service in different classes of works. A specification and some tabulated particulars of sizes, weights, &c., are included.

Messrs. Elliott Bros., Ltd., Central Buildings, Westminster.—New illustrated price list (Section 54, 32 pages) of Elliott recording instruments of a variety of patterns for switchboard and portable use.

The British Thomson-Houston Co., Ltd., Rugby.—Descriptive list No. 5,951, of 24 pages, fully describing their B.T.H. feeder voltage regulators—their principles, mechanical design, method of operation, efficiencies, &c.

Messrs. Ruston, Proctor & Co., Ltd., Lincoln.—Publication No. 3,483, illustrating and describing the Ruston exhaust gas-fired boiler for utilising the exhaust heat from internal-combustion engines.

The Sterling Telephone and Electric Co, Ltd, 210-212, Tottenham Court Road, London, W.—Ninth edition of their catalogue of telephones for all purposes; also electric bells, indicators, fire alarms, batteries and wires. In the course of its 160 pages, which are very fully illustrated and contain descriptive notes and particulars of prices, the following items are noticed:—A double-pole "Bell" receiver, British Post Office standard in

enamelled drawn brass case; a domestic hand-combination set, finished in cream and gold; "equipoise" arm for carrying G.P.O. table sets, keeping the telephone always handy yet never in the way; a sanitary glass mouthpiece, for use with G.P.O. wall sets and table sets, which shows all dust and dirt, and is easily removed and cleaned; a special clock for timing trunk calls; a conversation counter for checking message rate accounts; "Ferro case" 'phones, fitted in enamelled drawn steel cases, suitable for all climates; "Primax" interphones in a variety of patterns, including a new "factory" interphone, specially designed to stand rough handling; secret interphones with lamp signals; a comprehensive range of 'phones for use in mines, all complying with the Home Office requirements; electric blasting machines to comply with Home Office requirements; a complete range of iron-case bells; a new mechanical replacement bell indicator; and a new range of cables for interphone systems, with enamelled wire conductors. The same company has sent us a 28-page illustrated and priced pamphlet describing the "Sterling" car lighting system for motor-cars and boats, also electric horns, sparking plugs and other accessories for motor-cars.

The Electrical Co., Ltd., Charing Cross Road, London, W.C.—No. 3 of the *E.C. Journal* contains February metal price curves, an illustrated account of the firm's small machine factory, with notes on the Nitra lamp, house water pumps, electrical advertising, C.C. ampere-hour meters, and stock lists of dynamos and motors.

Messrs. Hans Renold, Ltd., Brook Street, Manchester.—24-page pamphlet dealing with the use of Renold chains in a Keighley electrically-driven woollen mill. The latter half of the publication is devoted to a reprint of the illustrated description of the electrical equipment of the mill (Messrs. Clough, of Keighley), which appeared in the Electrical Review in June, 1912.

Messrs. S.A. Industries Chimiques Chiasso (Suisse).—Brochure relating to the merits of "Isolit," which, it is claimed, is the best means of fixing porcelain insulators to iron supports, being unaffected by heat and cold, prepared with water, slow in setting, and firmly binding, while it is also an excellent insulator.

Messrs. Abercrombie & Son, 36, Whitfield Street, Tottenham Court Road, London, W.—16-page pamphlet illustrating and pricing some examples of choice electric candle fittings, such as they keep in stock, these including Adam, Georgian and Jacobean and all classic styles.

Liquidations. — The Stolz Electrophone Co. (1913), Ltd.—Under a compulsory winding-up order made against this company, the statutory first meetings of the creditors and shareholders were held last week at the London Bankruptcy Court. There was a large attendance of shareholders, and considerable resentment was displayed at the inanition of the directors by the investors who had lost money in the company.

Mr. H. E. Burgess, Official Receiver, made a lengthy report.

In the course of a discussion which ensued, a shareholder asked if any steps had been taken by the directors to ascertain the whereabouts of Mr. Holt, who recently disappeared.

Sir John Thrift, the chairman of the board, said he had not the slightest notion where Mr. Holt was at the present time. When the catastrophe occurred, the board were of opinion that the facts ought to be laid before the Public Prosecutor, with a view to the issue of a warrant for that gentleman's arrest. It was believed that in the first instance Mr. Holt went to New York, but it was subsequently rumoured that he had gone to South America.

A shareholder thought it was impossible for the present crisis to have come about without the directors knowing something about it.

Asked regarding the issue of the share certificates, Sir J. Thrift said he did not sign the certificates for the bogus applications for the 30,000 shares, and in fact he knew nothing about them until Mr. Holt had absconded.

Dr. Clarke said he had signed certificates without the transfers at the request of Mr. Holt. He knew nothing about the business side of company business, but joined the board as a medical man to deal with the investment part of the business, and did so with the consent of the Medical Council.

A decided opinion was expressed by shareholders that the directors had been guilty of gross negligence, and that steps should be taken to enforce their responsibility and recover some of the money subscribed.

The liquidation was left in the hands of the Official Receiver, who observed that it was perfectly obvious that the directors did not know their duties. It was further intimated by a shareholder that an action had already been commenced against the directors, and the whole circumstances would, in due course, be ventilated in the Courts.

Electromotor Equipment Co., Ltd.—A meeting of creditors is called for April 14th at 21, Old Broad Street, E.C., by the Liquidator, Mr. O. Steiner, to whom claims should be sent forthwith.

Osram Half-Watt Lamp in Street Lighting.—The Metropolitan Electric Supply Co., Ltd., before January 16th, installed a 105-volt 1,500-watt half-watt Osram at the corner of Vernon Place and Southampton Row, W.C., this being, we believe, the first of the new lamps used for street lighting in London. The half-watt Osram is contained in a lantern originally used for a cluster of three standard tungsten lamps, a new reflector having been fitted to accommodate the single unit. The result is said to be extremely good, and the illumination remarkable when compared with the high-pressure gas lighting in the vicinity.

Bankruptcy Proceedings. — Frederick Isaac Behrens (trading as Fred Burns), electrical engineer, 16, Market Street, Barnsley, Yorkshire.—The public examination of the above debtor was held at the County Court Hall, Regent Street, Barnsley. The debtor's statement of affairs showed a deficiency of £276, but this had since been amended to £133. Debtor attributed his failure to sickness of himself, bad debts, loss by fire, loss by stock being stolen when being taken to jobs, and loss on contracts. In his deficiency account the debtor placed his expenses incidental to illness, including specialists' fees, at £91, and loss by fire at £25. The Official Receiver (Mr. Basil S. Briggs) stated that debtor commenced business for himself in October, 1909, and had no capital. The beginning of his difficulties was in November, 1911, when he lost nearly £90 through the lessee of an entertainment hall in Barnsley becoming bankrupt. About that time his health broke down and he had been under doctor's treatment intermittently for various ailments ever since, and had incurred considerable expense for expert advice and treatment. By a fire at his shop last midsummer he lost £25. Debtor's wife was the tenant of the house and shop and she claimed the household furniture. Answering the Official Receiver, debtor said that owing to ill-health he had since December last been quite unable to attend to his business. He had employed four men, their wages being about £5 per week. He had lost very little on contracts, but he had lost money in giving discount in order to obtain payment of accounts owing to him. He did not know he was on the wrong side until December last. The examination was closed, the Registrar remarking that it was an unfortunate case.

J. W. Garsden (J. W. Garsden & Co.), electrical engineer, Blackburn.—Last day for receiving proofs for dividend, April 10th. Trustee, J. Smith, 27, Ainsworth Street, Blackburn.

L. Joseph Holt, lately the managing director of the Stolz Electrophone Co., Ltd., 85, Fleet Street, E.C.—A sitting of the London Bankruptcy Court was appointed to be held last week before Mr. Registrar Hood, for this public examination. The receiving order was made on January 30th, at the instance of Messrs. Dyer Bros. & Thomas, stockbrokers, 3, Finch Lane, E.C., creditors for £130. The act of bankruptcy cited was failure of the debtor to comply with the requirements of a bankruptcy notice duly served upon him. An order of adjudication was made on February 20th, and at the first meeting of creditors, Mr. F. S. Salaman, C.A., 1 and 2, Bucklersbury, E.C., was appointed as trustee, to act with the assistance of a Committee of inspection. Proofs of debts to the amount of £3,631 have been sent in by creditors. A registered letter containing notice of the proceedings was sent to the debtor at 85, Fleet Street, but was returned by the secretary to the Stolz Electrophone Co., with the intimation that the debtor was no longer connected with the concern. Mr. F. T. Garton, Official Receiver, reported that the debtor had not surrendered to the proceedings, and nothing was known regarding his movements or present whereabouts. Under those circumstances he asked for the sitting to be adjourned *sine die*. His Honour made an order in those terms. Messrs. Daniell & Glover represented the petitioning creditors.

T. M. Woodcock, electrical engineer, Sheffield.—First meeting April 8th; public examination April 23rd.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. 52, No. 231. April. London: E. & F. N. Spon, Ltd. Price 3s. 6d.—This issue contains papers on "The Design of Rolling Stock for Electric Railways," by H. E. O'Brien, and "Steam Boiler Working in Electrical Power Stations," by J. W. Jackson.

"*Transactions* of the North-East Coast Institution of Engineers and Shipbuilders." Vol. XXX, Part 3. March. Newcastle-on-Tyne: The Institution. Price 5s.

"The Principles of Automatic Telephony." By Walter Atkins. London: *Electrician* Printing and Publishing Co., Ltd. Price 2s. net.

"*Transactions* of the University of Toronto Engineering Society." Vol. VIII, No. 10. February. Toronto: The University.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXIII, No. 3. March. New York: The Institute Price $1.

"*Giornale* ed Atti della Associazione Elettrotecnica Italiana. Vol. I, Nos. 5 and 6. March 15th and 25th. Milan: The Association. Price L. 1 each.

"The Passenger Transport Problem." Report of the Special Sub-Committee of the Manchester Corporation. Manchester: Corporation Tramways Department.

Russia.—In the statement of foreign trade for 1913, just issued by the Russian Custom House Department, it is observed that there has been an exceptionally rapid advance in the importation of dynamo-electric machines and electric motors of all kinds. The weight in 1913 amounted to 383,000 poods; the corresponding movement in 1911 was represented by only 211,000 poods, in 1909 by 143,000 poods, and in 1907 by 91,000 poods.—*Financier.*

Lantern Slides.—Messrs. Browett, Lindley & Co., Ltd., of Sandon Works, Patricroft, Manchester, have a number of lantern slides of their high-speed engines, consisting of photographs of various types and drawings for same, which they will be pleased to lend to lecturers for any suitable paper they may be giving on high-speed steam engines.

For Sale.—The Felixstowe and Walton U.D.C. has for disposal a 150-kw, C.C. dynamo; Rotherham Corporation has for disposal a Harris-Anderson patent oil extraction and filtering plant. Particulars are given in our advertisement pages to-day.

Trade Announcements.—Messrs. J. E. & S. Spencer have removed their offices to 16, Dowgate Hill, London, E.C., and their warehouse address is now 33, Dowgate Hill, E.C.

The Stirling Boiler Co., Ltd., are to-day removing to 54, Victoria Street, Westminster, S.W. Telephone number unaltered.

The London offices of Messrs. Saville & Walton are now at 39, Victoria Street, Westminster, S.W.

Messrs. Norton & Gregory, Ltd., have opened a branch office at 6, Budge Row, E.C., where they have installed electric plant for plan copying by all processes.

Messrs. Ward & Goldstone, of Manchester, announce that, owing to increased business in Scotland, they have opened larger premises at 50, Wellington Street, Glasgow, where they occupy the first floor, and have large offices and showrooms. Scottish inquiries should be sent to that address.

Catalogues for Alberta.—Mr. G. M. Hall, Industrial Commissioner of the City of Edmonton, in the Province of Alberta, suggests that British manufacturers who wish to extend their overseas trade should furnish him with copies of their catalogues. He will be pleased to place them upon record in his office, and advertise the fact in the hope that it may serve to help merchants in his neighbourhood to obtain some kinds of goods that they do not get now, and also to help British manufacturers to sell their goods in Edmonton.

Deed of Assignment.—M. Sims, electrical engineer, late of 46, Leigh Road, and Milton Road, Southend-on-Sea. Claims must be sent by April 21st to the trustee, Mr. J. Mortimer, of 3, Pancras Lane, Queen Street, E.C.

The Argentine Republic.—From the preliminary returns which have lately been issued with regard to the imports into the Argentine Republic during last year, we learn that the imports of electrical goods attained a value of 7,027,000 gold pesos, as compared with 6,862,000 pesos in 1912.

Thames Ironworks.—According to the *Times* the engineering departments of the Thames Ironworks Co. at Greenwich are to be re-opened at an early date, giving employment to 1,500 to 2,000 men.

Exhibition.—The fifth International Printing, Stationery, Box-making and Allied Trades' Exhibition is to held at the Royal Agricultural Hall, Islington, N., from May 13th to 30th.

LIGHTING and POWER NOTES.

Argentina.—The Municipality of Paso de los Libres (Corrientes) has signed a contract with Messrs. Moran & Saldana, for the erection of an electricity works, which is to be completed within a year.—*Review of the River Plate.*

Australia.—The Leederville (W.A.) Council is raising a loan of £5,000 to extend its electrical plant.—*Tenders.*

Basingstoke.—Street Lighting.—The T.C. has given notice that in six months' time it will convert 59 street lamps, at present lighted by gas, to electric lighting.

Bexley.—New Plant.—The U.D.C. has decided to apply to the L.G.B. for a loan of £5,500 for additional plant at the generating station. The Council has decided to offer a supply of current in bulk to the Foots Cray Electricity Supply Co., at the rate of £3 5s. per KW. and 3d. per unit.

Blackrock.—E.L. Scheme Adopted.—After considering several E.L. schemes, Mr. Tierney, the consulting engineer, has recommended the U.D.C. to generate its own electricity. The Council has adopted this scheme, and instructed Mr. Tierney to prepare plans, &c.

Bolton.—Proposed Loan.—The Electricity Committee has decided to borrow £23,023 in connection with the alteration of the distribution systems, and £5,000 for the equipment of a proposed sub-station at Shifnal Street tramcar shed.

Loan Sanction.—The L.G.B. has sanctioned the borrowing by the T.C. of the following sums in connection with the Back-o'-th'-Bank electricity works:—£7,277 for steelwork, viaduct and foundations; £4,367, as to £2,610 for suction ash-handling plant, £783 for coal tippler, and £974 for electric capstan and ballards; £3,314, as to £1,556 for coal-conveying plant, £625 for coal-weighing plant, £163 for weighbridge and £162 for water meters.

Bradford.—Last week representatives of the West Riding Electrical Contractors' Association joined a deputation representing the plumbers' and gasfitters' interests, which waited upon the Gas Committee of the Corporation to protest against the proposal for opening a shop by the Gas Committee. The deputation were assured that the Corporation, in the new premises referred to, would not sell any articles of its own, but would merely offer facilities for local traders in gas apparatus to display their goods effectively, marked with the name of the trader and price of the article, and in cases in which a sale was effected the money would be handed over to the tradesman concerned. This is said to be a much more favourable position for the plumber, ironmonger and gasfitter than is enjoyed by the electricians.

Bradford-on-Avon.—E.L. Scheme.—The R.D.C. has waived its option to purchase the proposed E.L. undertaking. The whole of the works will not be in the Council's area, and the Council has taken this step rather than lose the scheme. The U.D.C. has approved of the agreement with Mr. J. H. Edwards, the promoter of the scheme.

Bramber and Beeding (Sussex).—Proposed E.L.—Efforts are being made to secure a supply of electricity for public and private lighting in these villages from Steyning.

Brazil.—According to the *Board of Trade Journal*, the concession granted to Sr. Brando for the utilisation of the hydro-electric power of the Sao Francisco River, reported in our last issue, has been annulled. The Paulo Affonso falls are stated to be the largest in South America, with a greater volume of water than Niagara.

Burnham (Somerset).—E.L. Inaugurated.—On Wednesday, last week, the electrical street lighting was switched on for the first time; the lamps are attached to the old gas standards.

Canada.—The Westmount (P.Q.) City Council has been authorised to borrow $125,000 to improve its electric lighting system; all the present overhead wires are to be placed underground.—*Canadian Electrical News.*

Cleveland.—L.G.B. Inquiry.—An inquiry was held by Mr. H. R. Hooper last week into the application of the Skelton and Brotton U.D.C. for powers to borrow £9,250 for the purpose of installing an E.L. system.

Continental Notes.—Spain.—A syndicate of French and Spanish capitalists has been formed to generate hydro-electric power in the little Republic of Andorra for transmission across the frontier to France.

Germany.—The erection of a large power station and distribution network is about to be commenced in the Bochum district of Westphalia. The first installation in the power house will comprise three 13,700-K.V.A. 5,000-volt turbo-generators each coupled to a 14,000-K.V.A. transformer, wound for 50,000 volts mesh, or 86,500 volts star.

Dartford.—Mr. J. F. C. Snell has been appointed to report on the proposed extension of the electricity works in order to give a supply to Crayford.

Devonport.—L.G.B. Inquiry.—Mr. P. M. Crosthwaite held an inquiry last week into the application of the T.C. for sanction to the following extensions at its electricity undertaking: New offices, £1,237; one turbo-alternator, with condensing plant, foundation, &c., £7,900; mains, £6,000; and services, £1,600; a total of £15,500.

Dublin.—Year's Working.—The accounts of the Corporation electricity department show that the surplus for the past year was £11,861, instead of the estimated surplus of £26,072. Owing to the strikes in the December quarter the accounts of factories and small shopkeepers decreased by over £4,000 as compared with previous years.

Durham.—School Lighting.—The C.C. has referred to a Special Committee for consideration a proposal made by the County of Durham E.P.D. Co., for the installation of E.L. at the County Industrial Schools.

Electric Cooking.—Speaking at a meeting of the Institution of Municipal and County Engineers at Torquay recently, the Torquay borough surveyor, in commenting on the success of the electric cooking apparatus at the municipal café, intimated that further extensions were under serious consideration to meet the demands made during the summer season. We understand that the Staffordshire Joint Small-Pox Hospital Board has decided to install an electric cooker at that institution.

Fife.—A new factory is to be erected by the British Aluminium Co. at Burntisland, on a site of 38 acres. Electrical power is largely used in connection with these works, and an extension of the manufactory at Kinlochleven is being made for the making of carbon electrodes.

Glasgow.—A commencement is being made with the erection of the new municipal power station at Dalmarnock Bridge. The foundations are now in hand, and all plans have been prepared.

Halifax.—Proposed New Plant.—The Tramways Committee has resolved to apply to the L.G.B. for sanction to borrow £2,800 for plant required at the electricity works, as follows:—Cooling tower, £1,500; fan, £850; D.C. feeder panel, £200; and test room equipment, £250.

Itchen.—Prov. Order.—The U.D.C. has decided to adjourn discussion as to the working of its prov. order *sine die*.

Keighley.—Proposed Extension of Supply.—The T.C. is considering the question of applying for a prov. order to supply electricity to districts outside the borough, including the area of the R.D.C.

Liverpool.—Loan Sanction.—The City Council has received sanction to borrow £10,000 for electric sub-station equipment.

Leeds.—Electricity Works Extension.—Important proposals were to come before the Leeds City Council on Wednesday, for increasing the plant at the electricity works in Whitehall Road. The scheme is estimated to cost £200,000, by means of which the capacity of the station will be more than doubled. The Committee proposes to install a 12,000-kw. turbo-alternator and condensing plant, six boilers, switchgear, &c. Part of the present plant will be abolished, and, if possible, sold. At present there are three engine houses, and two of these will go; also a switch room, and one of the boiler houses. The full scheme will involve the purchase of adjoining land and premises for extension of the generating station.

London.—Woolwich.—Bulk Supply to Foots Cray.—The Foots Cray E.S. Co. has applied to the Woolwich B.C. for a bulk supply of electricity within its area, and the Electricity Committee has recommended the B.C. to submit terms, and, subject to the offer being accepted, to apply to the L.C.C. for a loan of £4,290 for the necessary mains, switchgear and transformers.

Luton.—Workhouse Lighting.—The B. of G. has appointed a Committee to consider the advisability of installing an independent E.L. plant at the Workhouse, which arrangement it is considered will be cheaper than the public supply.

Passage West (Co. Cork).—Proposed E.L.—A public meeting has unanimously approved of a proposed E.L. scheme, and appointed a Committee to proceed with the undertaking. The cost is estimated at £3,000.

Queenstown.—Street Lighting.—The U.D.C. has recently opened tenders for the street lighting, that for gas lighting in the outside area showing a considerable increase, while the Electric Lighting Co.'s tender for arc and incandescent lighting remained as previously, with the offer of a reduction if 24 gas-lighted lamps in its area are transferred.

New Zealand.—The Hastings Council has been authorised to borrow £68,250 for public improvements, including the installation of electric lighting.—*Tenders.*

North Bierley.—Workhouse Lighting.—The B. of G. has decided to install electricity at the workhouse at Clayton, in place of gas. The cost is estimated at £1,000, and the annual saving at about £70; the present gas bill amounts to £450 per annum.

Rawtenstall.—L.G.B. Inquiry.—Mr. H. R. Hooper held an inquiry last week into the application of the T.C. for permission to borrow £10,000 for the electricity undertaking, and £1,000 for public lighting.

Redditch.—New Plant.—The report of Messrs. Handcock & Dykes on the electric light undertaking, has been considered by the E.S. Committee. The report met with approval, but before arriving at a decision upon the recommendations mentioned therein, the Committee decided to obtain from Mr. Handcock further particulars relating to the new plant, which he advised must be installed in any case without delay.

Reigate.—Prov. Order.—The R.D.C. has consented to a prov. order for E.L. at Banstead, Walton-on-the-Hill and Kingswood, being granted to Mr. G. Allom, satisfactory terms and prices having being arranged.

Salford.—The T.C. is to enter into an agreement with Messrs. Willans & Robinson for remedying the inefficiency of two turbo-generators at the electricity station. The Electricity Committee proposes to enter into agreements with J. Mandleberg & Co., and the Albion Waterproofing Works for the supply of electricity, subject to a minimum demand of 50,000 units per quarter, the charge to be '9d. per unit for the first 37,500 units in each quarter, and '75d. for all units in excess.

Saddleworth.—The U.D.C. having applied to the Stalybridge Joint Tramways and Electricity Board with regard to a supply of electricity, the latter has expressed its willingness to grant the supply on terms.

Seaton Delaval.—Overhead Wires.—The Newcastle-on-Tyne E.S. Co. has obtained the sanction of the local authorities for the erection of overhead wires through Longbenton and Seghill to Seaton Delaval, for the transmission of electricity at 20,000 volts pressure, and the consent of the B. of T. is being sought.

South Africa.—The Beaufort West (Cape Province) Municipality has been authorised to expend £10,000 on an E.L. scheme, the consulting engineer for which is Mr. Chas. G. Trevett, of Cape Town.

Southend-on-Sea.—Loan for Diesel Engine Sub-Stations.—The T.C. is to apply to the L.G.B. for powers to borrow £14,510 for the purchase from Messrs. Belliss & Morcom, Ltd., of five Diesel engines for the Leigh and Thorpe Bay sub-stations.

Street (Somerset).—E.L. Scheme.—The sum of £3,700, which is in excess of the amount required, has been subscribed for the proposed E.L. scheme, and ample guarantees having been secured, the scheme is to proceed.

Tunbridge Wells.—New Plant.—The Lighting Committee has recommended the T.C. to invite tenders for an atmospheric exhaust pipe, feed water pump, four new switchboard panels and mechanical stokers for three boilers.

Upper Greetland (Yorks.).—Public Lighting.—The Parish Council has accepted an estimate of the Yorkshire E.P. Co. for the public lighting of the district, through which the company's mains pass.

West Bromwich.—Proposed Mains Extensions.—The Electricity Committee has recommended the T.C. to extend the electricity mains in the Great Bridge district, at an estimated cost of £1,450.

West Wickham.—The West Kent Electricity Co. has informed the B. of T. that it is now in the position to supply electricity to West Wickham.

Worthing.—Year's Working.—The surplus on the electricity undertaking for the past year was £1,008, and it is proposed to transfer £500 to the relief of the rates, leaving £508 to be carried forward. The estimated surplus for the year ending March, 1915, after placing £500 to the depreciation fund and paying £120 income-tax, is £617.

TRAMWAY and RAILWAY NOTES.

Australia.—Mr. T. B. Molomby, the passenger superintendent, and Mr. E. B. Jones, the secretary of the Victorian Railways, have left for Europe and America to study the working of electric railways in order to be in a position to deal with the electrified Melbourne suburban railways, which will commence running next year.

Blackpool.—Year's Working.—The receipts of the Corporation Tramways Department for the past year showed an increase of £12,700 over the preceding year. It is anticipated that £15,000 of the profits will be allocated to the relief of the rates.

Burnley.—Goods by Tramway.—The experiment of carrying heavy goods on the Corporation tramways is to be abandoned, owing to the business obtained being insufficient to warrant its continuance.

Colne.—Light Railway Purchase.—The Corporation took over the undertaking of the Colne and Trawden Light Railway Co. on Tuesday midnight, last week.

Continental Notes.—Germany.—It is reported that the Prussian Government is considering the question of establishing a State-owned electric power station to supply the Berlin Metropolitan and District Electric Railways.

For the North-South Underground Railway of the Berlin Municipality, now under construction, a direct current pressure of 1,000 volts has been adopted; trials of the new rolling stock are in progress. The existing underground railways work at 650-700 volts, the tramways at 500 volts, and the Prussian State railways have adopted the single-phase system.

With the financial support of the Hessian Government, the Siemens-Schuckertwerke are to construct a tramway between Bensheim and Sindenfels, near Darmstadt.

An electric railway is to be constructed from Danzig to the seaside resort of Brösen.

Sweden.—Electric traction has been adopted on the Stockholm-Saltsjobaden suburban railway, a single track line, 9¼ miles long, with only two cross-overs. The trains consist either of one or two motor vehicles and trailer cars. The trailers consist of old railway carriages carrying from 72 to 90 passengers. The motor vehicles, which seat 64 persons, run on two four-wheel bogies; they are fitted with two 110-kw. motors geared to the bogies with a ratio of 1 to 4. The motors are controlled by a master switch, operating on 65-volt current delivered by a transformer mounted on the vehicle, and which also supplies the current for the lamps. The cars are also fitted with electric heaters. Alternating current at 6,000 volts, 25 cycles is taken from the Stockholm municipal power station and converted to direct current at 1,350 volts at a transforming station located about mid-distance on the line.

Luxemburg.—The Chamber of Deputies has decided to grant a subvention of £40,000 towards the cost of an electric tramway between Luxemburg, Hollerich and Esch-sur-Alzette. The line will be worked by the Continentale Eisenbahnbau und Betriebs Gesellschaft under a 20 years' concession.

Spain.—The Trans-Pyrenean Railway Committee has been ordered to study a preliminary scheme for a double-track electric railway from Madrid to the French frontier through the Roncal Valley, Sangüesa and Soria, to be worked by the State.

Croydon.—Electric Vehicles.—On Thursday, last week, a demonstration of electric vehicles took place outside the Town Hall; both pleasure and commercial vehicles were shown, including the Edison, Lloyd and Torpedo types, of which particulars and illustrations have appeared in our pages.

Dover.—A report states that the reconstruction of parts of the tramway track will cost £3,477, and the Tramways Committee has decided to expend £1,500 this year on the most urgent repairs, and will carry out the remainder as soon as possible.

Mexborough.—Railless Traction.—It is stated that the Mexborough and Swinton Tramway Co. is shortly to construct a system of railless electric traction between Mexborough Toll Bar and Conisborough.

New Zealand.—Electric Vehicles.—The Wellington City Council has decided to purchase two electric vehicles, one for the collection of parcels and the other for the use of the tramways department.

Oldham.—Year's Working.—The total receipts of the Corporation tramways department for the year ended March 25th, 1914, showed an increase of £7,710. During the year the car-mileage increased by 24,364 miles, and the passengers carried by 1,341,233, while the current consumption decreased by 143,601 units. Wages increased by £4,750, and from £10,000 to £12,000 had been spent on the permanent way. The profit on the year's working was about £5,220.

Shipley.—Track Renewal.—The U.D.C. has decided to let out to contract the reconstruction and renewal of the tramway track, the Council providing the cement for, and supervision of, the work of laying the foundation. Using direct labour the surveyor estimated the cost at £8,365.

U.S.A.—According to the *Railway Gazette* it has now been decided to electrify the Chicago, Milwaukee and St. Paul Railway for part of the distance between Harlowtown, Mont., and Avery, Idaho, some 440 miles across the Belt, Rocky and Bitter Root mountain ranges. The first section to be undertaken will cover 113 miles of route, and it has been decided to adopt 2,400-volt direct-current traction, utilising regenerative electric braking instead of air brakes. It is expected to operate the section with 12 200-ton freight, four 200-ton through passenger and two 100-ton local passenger locomotives. The cost of installation is estimated at about £300,000, exclusive of locomotives. The above railway joins the Butte, Anaconda line, also a 2,400-volt D.C. system, which is described in this and the preceding issues of the Electrical Review.

TELEGRAPH and TELEPHONE NOTES.

Automatic Telephony.—Messrs. Davidson & Co., Ltd., have installed a system of automatic telephones throughout their Sirocco Engineering Works, Belfast. The apparatus was supplied by the Automatic Telephone Manufacturing Co., Ltd.

Cable Concession.—The concession granted to the India-Rubber and Gutta-Percha Co. for establishing submarine cables between Pernambuco and the West Coast of Africa by way of the Island of Fernando Noronha, has been transferred to the South American Cables Co.

Constantinople.—The newly-opened telephone exchange was recently thrown out of action for several days by a violent thunderstorm.

Dartford.—The U.D.C. will apply to the L.G.B. for sanction to the borrowing of £364 for the purpose of installing a system of public fire alarms and call bells.

Dundee.—Col. A. M. Ogilvie has intimated to a meeting of the Telegraph and Telephone Advisory Committee for Dundee that a scheme which will meet the requirements of the district for the next 15 years has been arranged. Fifteen miles of pipe line and about 3,600 miles of wire will be laid down at a cost of £14,000. It has also been decided to proceed with the construction of a new central exchange, which will be available in two years' time. The cost of the P.O. extension, in which the new exchange will be housed, will be about £18,000. Two additional lines will be laid, to Edinburgh and Glasgow. The cost of the new switchboard will be from £25,000 to £30,000, according to the system adopted, while from £6,000 to £14,000 will be expended upon new telephones.

Edinburgh.—Colonel A. M. Ogilvie stated at Edinburgh that they had made an estimate for the expected growth of the system for the next 15 years, and would have to establish a new exchange service in the south side of the city. In connection with that they would have to have a very extensive system of underground lines. The scheme would cost from £50,000 to £100,000, and probably the exchange and switchboard would cost from £70,000 to £80,000. He mentioned that the estimates for next year involved an expenditure on the national telephone system of £4,500,000.

Imperial Wireless System.—The idea of situating the Indian station of the chain at Bangalore has been abandoned, owing to the fact that the station being a long-range station, the transmitting and receiving stations have to be some 20 miles apart, and consequently, if Bangalore were chosen, the receiving station would be in British territory and the dispatching station in Mysore territory, or *vice versa*, which is considered to be undesirable. The authorities are investigating the possibilities of Poona as a site for the Imperial station; should this be found to be unsuitable, Ootacamund might possibly be chosen

On Thursday last week the cross-examination of Lord Murray before the Select Committee of the House of Lords was continued. The charge that Lord Murray had used his influence as Chief Whip to prevent discussion of the contract with the Marconi Co. was withdrawn. The evidence was concluded, and the Committee adjourned until Tuesday, but owing to the illness of Lord Halsbury, no sitting took place on that day.

Intercepting Wireless Messages.—A Russian telegraph engineer named Jhidkovsky, stationed at Zhonerinka, has been arrested on a charge of intercepting wireless messages between Government military stations and communicating them to a foreign Government.

London Telephones.—A Special Committee has been appointed by the London Chamber of Commerce, including members of the City Corporation, the County Council, and the Port of London Authority, to advise the Postmaster-General with regard to the telephone service. The Committee has appointed Sir C. J. Owens chairman.

P.O. Telegraphs and Telephones.—A White Paper has been issued showing the amounts received and expended on account of the telegraph and telephone services for the year ended March 31st, 1913. It shows that the gross amount received by the Post Office in respect of telegrams, telephone rentals and fees, private wire rentals, newspaper wire rentals, &c., was £9,656,671. With the sum of £811,889 deducted (£808,690, the amount paid to cable companies, foreign companies, &c., and £3,198, the amount of telegram moneys refunded), the gross amount received was £8,844,782. The gross amount received by the Post Office in respect of royalties payable by the National Telephone Co., Ltd., and other licensees was £1,659, and the value of telegraph and telephone services performed for other public departments without remuneration was £106,670. The balance of expenditure over receipts was £377,547. For the transmission of telegrams the sum of £3,909,608 was received. The administrative and operating expenses amounted to £3,025,036. The report of the Telephone Finance Committee shows that the surplus on the year's working, after allowing for interest on capital, amounted to £303,343, equal to 1·47 per cent. on the capital. The revenue for the year in relation to telephones amounted to £5,791,988. The administrative and operating expenses came to £1,469,266.

Rapid Telegraphy.—Messrs. Siemens & Halske are developing a new system of automatic telegraphy in which a perforated strip, having five parallel rows of holes, is used at the transmitting end, with five corresponding relays at the receiving end. Very high speeds are obtainable.

Wireless Telephony.—Successful transmission of the singing voice, but not the words sung, has been effected from the station at Laeken, near Brussels, to the Eiffel Tower, 225 miles away.

The Reineke system of wireless telephony is being installed at the Lindsay Colliery of the Fife Coal Co., Ltd., and will enable communication to be maintained with the innermost workings, even in the event of a disastrous explosion occurring.

Wireless Weather.—A wireless service has been organised, since November last, along the Austro-Hungarian coasts. Wireless meteorological reports are transmitted by the coast stations at Castelnuovo, Sebenico, and Trieste to ships asking for them for a fee of 4 kronen.

Meteorological reports are transmitted in Russia by the coast stations at Reval, Riga and Libau regarding atmospheric conditions in the Baltic. Information is supplied from the Nikolaiewski Observatory at St. Petersburg.

A wireless station has been constructed at the Royal Aeronautical Observatory at Lindenberg for the twofold purpose of disseminating weather reports throughout Germany for the benefit of airships and others, and of apprising airships of the occasions when captive balloons and kites have ascended from the Observatory. The captive balloons and kites, to the number of six or eight at a time, are fastened to strong steel wires, and as they rise often to heights of 6,000 metres, when deflected by a strong wind, form a serious danger zone to air navigation.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdeen.—April 15th. Installation of electrically controlled clocks in the new station for the Joint Station Committee. Specifications (10s. 6d.) from Mr. J. A. Parker, 80, Guild Street.

Austria.—Simmering.—April 8th. Supply of an electric motor wagon for a sliding platform, and three electrically worked capstans for the railway workshops at Simmering. Particulars, drawings, &c., (3 kronen), from Abteilung IV/6, Zugförderungs und Werkstä Hendienst der K.k. Staatseisenbahn Direction in Vienna.

Australia. — May 12th. P.M.G.'s Department. Standard batteries for all States; Schedule No. 1,010. See "Official Notices" to-day.

Victorian Railways.—May 13th. One hundred enclosed arc lamps. Deposit £5. Mr. E. B. Jones, acting secretary.

Victoria.—May 20th. Victoria Railways Commissioners. One three-phase slip-ring electric motor and accessories. Deposit £1. Local representation. A specification can be seen at the B. of T. Commercial Intelligence Department in London.

Melbourne.—April 27th. Overhead travelling cranes for sub-stations and lifting tackle for power stations, for Melbourne Suburban Railways. See "Official Notices" to-day.

Ballymena.—April 11th. B. of G. E.L. installation at workhouse and supply of steam engine, 20-kw. dynamo and steam pumps. Specification from Mr. F. D. Brown, Engineer, 93, Ann Street, Belfast.

Belgium.—April 16th. Electric lighting installation on the Bassin Canal and the new subsidiary basins. Some particulars (in French) can be seen at the B. of T. Commercial Intelligence Department in London.

Bootle.— April 22nd. Corporation. Supply of two 500-600-kw. rotary converters, transformers and switchgear for the electricity department. Forms of tender from the Borough Electrical Engineer, Electric Light Station, Pine Grove.

Bosnia.—Doboj.—April 20th. Municipal electric light installation for Doboj and Usora, comprising supply and erection of driving machinery, electrical equipment of the generating station, supply and erection of pumps and motors, complete distribution network for Doboj and Usora. Particulars from the Stadtgemunde, Dodoj, Bosnia.

Bray.—April 7th. U.D.C. General stores and stores for electric light works. See "Official Notices" March 13th.

Bristol.—April 15th. Arc lamp carbons and incandescent electric lamps for a year for the Docks Committee. Mr. W. W. Squire, Engineer, Cumberland Basin.

Colwyn Bay.—April 4th. U.D.C. Twelve months' supply of engine-room stores for the electricity works. Forms of tender from Mr. A. R. Tudman, Electrical Engineer, Ivy Street.

Devonport. — April 8th. 1,250-kw. turbo-alternator, with condensing plant, two 500-kw. rotary converters and switchgear, for the Borough Electricity Department. See "Official Notices" March 20th.

April 27th. Corporation Gas Department. Electrically-driven jib crane and coal hoppers. Specification, &c. (£1 1s.), from Mr. I. Carr, Widnes.

Dublin.—April 17th. Corporation. Twelve months' supply of arc lamp carbons. See "Official Notices" to-day.

Edinburgh.—April 6th. Midlothian and Peebles Asylum. Six months' supply of electric fittings. Forms of tender from the Clerk and Treasurer, 19, Heriot Row.

April 20th.—Corporation. Extension switchboard, for McDonald Road station. See "Official Notices" to-day.

Farnworth.—April 18th. U.D.C. Switchgear and cables. Mr. H. J. Hutchinson, Engineer, Electricity Works.

Germany.—April 20th. The municipal authorities of Bremen are inviting tenders for the supply and erection of six alternators.

Glasgow.—April 7th. Twelve months' supply of stores, fuel, &c., for the Tramways Department. Specification from Mr. J. Dalrymple, General Manager, 46, Bath Street.

April 9th.—Corporation. Rewiring the electrical installation at Haghill Works and Stables, Dennistoun, for the Corporation. Specification from Mr. D. McColl, 20, Irongate.

Gloucester.—Low-tension, paper-insulated cable, for the Electricity and Tramways Committee. See "Official Notices" March 27th.

Hyde.—April 6th. Corporation. Telephone installation in the new Town Hall extension. Mr. J. H. Fletcher, architect, Clarendon Place, Hyde.

Leeds.—May 11th. Corporation. Steam turbine, three-phase alternator and exciter, 12,000-kw., 1,000 to 1,500 r.p.m., and condensing plant. See "Official Notices" to-day.

Limerick.—April 17th. Corporation. Electrical accessories, service boxes, cables, &c. See "Official Notices" to-day.

London.—L.C.C. April 9th. Installation of 65 wiring points, 85 lights, and two power points, at Moxey Road centres, Woolwich. See "Official Notices" March 20th.

April 22nd.—L.C.C. Installation, 218 wiring points, 283 lights, at Wilson Street Elementary School, Islington, N. See "Official Notices" to-day.

Morocco.—April 18th. Four electric cranes and electric power plant. Firms desiring to tender should communicate with Mons. le President de la Commission Générale des Adjudications et des Marches, Dar-en-Niaba, Tangier. Moroccan contract regulations may be seen at the C.I. Branch of the B. of T., London.

New Zealand.—May 11th. Hydro-electric and sub-station plant for Tauranga. Specification, &c., from Messrs. H. W. Climie & Son, engineers, Tauranga. Deposit £2.

Wellington.—City Council Tramways Department. Two electric motor vehicles, one for parcels collection, and one for departmental use.

Nottingham.—April 16th. Twelve months' supply of stores for Corporation electricity department. See "Official Notices" to-day.

Portsmouth. — 2,000-kw. turbo-alternator complete, for Borough Electricity Department. See "Official Notices" March 27th.

Portugal.—May 16th. Electric railway between Lamego and the left bank of the River Douro (7½ miles). Construction and working. Direccao Geral das Obras Publicas e Minhas, Lisbon.—*Board of Trade Journal.*

Rathkeale (Co. Limerick).—April 18th. Gas engines and suction plant, dynamos, storage battery, switchboard, overhead lines and street lamps, for Rathkeale Electric Lighting and Power Co. See "Official Notices" March 27th.

Rochdale.—April 15th. Corporation. Boiler feed pumps and crane. See "Official Notices" March 27th.

Rosslynlee.—Mid-Lothian and Peebles District Asylum invite offers for supply of electric fittings. The Clerk, 19, Heriot Row, Edinburgh.

Salford.—April 6th. Corporation. Supply of one 10-ton travelling crane at sub-station for the Electricity Committee. Particulars from the Borough Electrical Engineer, Electricity Works, Frederick Road, Pendleton.

Spain.—The municipal authorities of Guejar Sierra (Province of Granada) have just invited tenders for the concession of the electric lighting of the town.

The Spanish Post and Telegraph authorities in Madrid are about to invite tenders for the establishment of telephone lines between Aranda de Duero and Irun, and between Burgos and Santander.

Torquay.—April 20th. Corporation. Two water-tube boilers, fuel economiser, steam pipes, valves, &c. See "Official Notices" to-day.

Tunbridge Wells.—April 30th. Corporation. 4,000 tons of small coal for use with Underfeed stokers. Borough Electrical Engineer.

April 22nd.—Corporation. 300-kw. steam prime mover, alternator and exciter, condenser with air and circulating pumps. See "Official Notices" to-day.

Tyrol.—Hall.—May 2nd. Installation, complete, of a single-phase mine railway in the State salt mines; also supply of a single-phase alternate current locomotive and 15 iron mine trucks and a revolving tipper. Particulars of the K.k. Salinen-verwaltung, Hall, Tyrol.

Wallasey.—April 7th. Steam and electrical plant, &c., for the Borough Electricity Department. See "Official Notices" March 13th.

Walthamstow.—April 24th. U.D.C. One water-tube boiler and pipework, overhead bunkers and conveying plant, cast-iron circulating water pipes, for the Electricity Department. See "Official Notices" to-day.

Warrington.—April 14th. One year's supply of motors and transformers, for the Borough Electricity Dept. See "Official Notices" March 27th.

Wigan.—April 18th. Corporation. Electrical accessories, service boxes, cables, &c. See "Official Notes" March 27th.

April 18th.—Corporation. Tramcar accessories, brake blocks, overhead line material, &c. See "Official Notices" to-day.

April 20th. Corporation. H.T. feeder cable, transformer and switchgear. See "Official Notices" March 27th.

CLOSED.

Admiralty.—The Aster Engineering Co. has recently received orders from this department for two engines for 35 H.P. generating sets (22 kw.) for lighting, and one for a 28-H.P. marine engine set.

Australia (Queensland).—P.M.G's. Department.

112 microtelephones and accessories, £125.—Western Electric Co. (Australia), Ltd.

Victorian Public Works Department.—

Four electric motors, £198.—Siemens Bros. Dynamo Works, Ltd.

Sydney Harbour Trust.—

Eight pairs electrically-operated conveyors, for Woolloomooloo Bay.—Gilson, Battle & Co., Ltd.—*Tenders.*

Birmingham.—The Corporation Tramways Department has accepted a tender for 25,000 Osram traction lamps for use on its cars.

Blackpool.—The Tramways Committee has accepted the tender of the United Electric Car Co. for the supply of six new "toast-rack" cars.

Bridlington.—The T.C. has entered into an agreement with the Chloride Electrical Storage Co., Ltd., for the entire replating of the negative plates in the battery, the Council to pay £250 for the replating, and £100 a year for maintenance for the remainder of the present agreement for 12 years.

Bristol.—The Docks Committee of the T.C. has accepted the tender of Messrs. Herbert Morris, Ltd., for a second overhead electric travelling gantry, for Bathurst Wharf.

Brussels.—Four firms tendered for the supply to the Société Nationale des Chemins de Fer Vicinaux, of Brussels, of tubular telescopic metal posts for electric traction lines, in four lots, the lowest offers being:—First lot, Thyssen et Cie., 16,400 fr.; second lot, same firm, 14,700 fr.; third lot, Mannesmann Rohrenwerke, 21,377 fr.; and fourth lot, same firm, 12,826 fr.

Canada.—The Winnipeg City Council has awarded the Canadian Westinghouse Co. a contract for switchgear at the King Street sub-station, the estimate for which was $16,828.—*Canadian Engineer.*

Croydon.—The B.C. has accepted the tender of Callender's Cable and Construction Co., Ltd., for electric cables for one year.

Darwen.—The Education Committee has accepted the tender of Mr. W. V. Fairhurst, for electric lighting at Spring Bank School.

Derby.—The T.C. has accepted the following tenders:—

Babcock & Wilcox, Ltd.—Boiler, £1,900.
F. W. Brackett & Co., Ltd.—Water screen, £278.
E. Morley & Sons.—Extension of flooring and turbine bed, £330.
J. H. Fryer.—Trench work, £448.
B.I. & Helsby Cables, Ltd.—High-tension cable, £887; and hard-drawn copper.

Egypt.—According to a statement in the *Times*, the Egyptian Government has placed a contract with Messrs. Sulzer Bros., Switzerland, for a large pumping installation to be erected near Baltim, in the Delta of the Nile. The contract includes four water-tube boilers, eight 400-B.H.P. Sulzer-Diesel engines, six 475-B.H.P. Sulzer-Uniflow steam engines, each set of engines being direct-coupled to a pump. A Diesel electric lighting installation and other equipment are also included.

Germany.—Messrs. Mossay & Co., Ltd., of Westminster, state that their works have received an order for two Lloyd street-washing machines from the City of Leipzig.

Hereford.—The contract for the whole of the electrical installation work for the New Theatre has been secured by Messrs. Walker & Co., Hereford.

Ilford.—The following tenders have been accepted by the U.D.C. Electricity Committee for annual supplies:—

C. Macintosh & Co., Ltd.—Cables.
Union Electric Co., Ltd., and the Sloan Electrical Co., Ltd.—Conradty arc lamp carbons.
Cryselco, Ltd.; Electrical Manufacturing and Supplies Co., Ltd.,; and Pope's Electric Lamp Co.—Incandescent lamps.
Ferranti, Ltd.; Siemens Bros. and Reason Manufacturing Co., Ltd.—Meters.
W. Lucy & Co., Ltd., and Reason Manufacturing Co., Ltd.—House service fuse boxes.
W. Lucy & Co., Ltd.—Joint boxes.
Edison & Swan Co., Ltd.—Main switches.

Leyton.—The U.D.C. has accepted the tender of Messrs. Wm. Cory & Son, Ltd., for Mansfield nutty slack for the electricity works for a year, at 11s. 10d. per ton.

Llandudno.—The Electricity Committee has accepted the tender of the Tudor Co., amounting to £1,215, for replating the battery.

London.—L.C.C.—The Education Committee reports that tenders for electric lighting the undermentioned schools are expected to be received during the Easter recess, and recommends that the chairman, and vice-chairman of the Council, with the chairman and vice-chairman of the Education Committee, and of the Building Sub-Committee of the Education Committee, be authorised during the recess to accept the lowest satisfactory tender in each case: Wilson Street, Islington; Furzedown Training College and Hostels, Wandsworth; Bloomfield Road, Central (Maxey Road centres) Woolwich.

The following tenders have been received by the Education Committee for installing electric light in the Upper Marylebone Street School:—

Napier, Kimber, Ltd. (accepted)	£257
Lund Bros. & Co.	294
Arthur Newman, Ltd.	297
Alpha Manufacturing Co.	303
R. H. and J. Pearson, Ltd.	306
C. H. Cathcart & Co.	£315
Malcolm & Allan, Ltd.	328
W. Dickinson & Co.	333
J. and F. May	379
G. P. Allan & Co.	390
G. Weston & Sons, Ltd.	399

The Highways Committee reports for the supply of eight motor wagons for use in connection with the renewal and repair of the tramways permanent way, that the following tenders have been received. For six 5-ton steam motor wagons:—

	Steel tires.	Rubber tires.
Foden's, Ltd. (recommended)	£3,490	£4,140
Mann's Patent Steam Cart and Wagon Co., Ltd.	3,642	4,302
Leyland Motors, Ltd.	3,636	4,500
R. Garrett & Sons, Ltd.	3,690	4,500
Yorkshire Commercial Motor Co.	3,891	4,572
Clayton & Shuttleworth, Ltd.	4,110	4,880
W. Allchin	4,200	4,770

For two 2-ton petrol motor wagons:—

Alldays & Onions Pneumatic Eng. Co., Ltd. (recommended)	£905
J. I. Thornycroft & Co.	1,002
Commercial Cars, Ltd.	1,050
Leyland Motors, Ltd.	1,056
" (alternative for 2½-ton wagons)	1,230
Dennis Bros (1913), Ltd.	1,090
J. & E. Hall, Ltd.	1,126
Albion Motor Car Co.	1,134
Daimler Co., Ltd.	1,183
Wolseley Tool & Motor Car Co., Ltd.	1,190

The Committee recommends that Foden's, Ltd., be allowed to sublet to H. Morris, Ltd., the jib cranes required in connection with the supply of the six 5-ton steam motor wagons, and that Alldays & Onions Pneumatic Engineering Co., Ltd., be allowed to sublet to the Atlas Resilient Steel Wheel Co., the steel wheels required in connection with the supply of the two 2-ton petrol motor wagons.

Stepney.—The Electricity Committee recommends that the offer of Messrs. Reyrolle & Co. (patentees of the type of switchgear used by the Council) be accepted for the extensions to the high-tension switchgear at the Limehouse Station and Osborne Street sub-station at £900; also that the offer of Messrs. Strachan and Henshaw be accepted for providing a second telpher for handling coal and ashes at the Limehouse Station for use on the existing apparatus, at £585.

Plymouth.—The T.C. has accepted the tender of the Lorain Steel Co. for 100 tons of tram rails, with fishplates and joints, at £746. The only other tender was that of Walter Scott, Ltd., Leeds, at £747.

Salford.—The T.C. has accepted the following tenders for supplies to the Tramway Department—biennial supplies:—

Car Accessories (Electrical) Insulating Materials.

British Westinghouse Co. (approx. value of contract)	£1,080	Micanite and Insulators Co.	£148
General Electric Co.	17	Wm. Geipel & Co.	400
Wm. McGeoch & Co.	99	Manchester Armature Repair Co.	529
John Hall	12	Fleming, Birkby & Goodall	69
L. Andrew & Co.	110	W. Boydell & Sons	144
C. Macintosh & Co.	27	Tramway Supplies	17
Ward & Goldstone	54	Gabriel & Co	18
Reddaway & Co.	16	Le Carbone	78
North British Rubber Co.	74	H. Norbury & Co.	218

Car Accessories (Mechanical).

John Hall	£69	Tandem Smelting Co.	£573
R. & H. F. Phillips	28	Shoston Bros., Ltd.	306
Brown, Bayley's Steel Works	387	Tramways Supplies	54
Brecknell, Munro & Rogers	337	Vaughan Bros.	250
Gabriel & Co.	52	Malleable Steel Castings Co.	42
National Rail and Tramway Appliances Co.	1,122	Watlington & Co.	27
G. H. Allsop	550	John Baker & Co.	1,625
Phosphor Bronze Co.	20	British Hele-Shaw Patent Clutch Co.	943

Special Car Accessories.

British Westinghouse Manufacturing Co., and Dick, Kerr & Co.

Special Paints, Varnishes, &c.

Nobles & Hoare, Ltd.	£238
Docker Bros.	149

Ears, Frogs, Pull-Offs, &c.

Alfred Wiseman, Ltd.	£17	B.I. and Helsby Cables Co.	£19
Brecknell, Munro & Rogers	94	Forest City Elec. Services Supply Co.	16
John Hall	13	Brit. Westinghouse Co.	10
Watlington & Co.	94		

Glass.

S. Gratrix, Jun., Bros., Ltd.	£165
Pilkington Bros.	136

Special Overhead Equipment.

B.I. and Helsby Cables Co.

Wire, Solder, Lead, Tin, &c.

John Hall	£150
J. Bassett	34
L. Andrew & Co.	96

Special Car Accessories.

British Westinghouse Co.	£903

Annual supplies:—

Insulating Materials.

Siemens Bros. Dynamo Works	£684

Paints, Oils, &c.

British Petroleum Co.—Petroleum	£106
Anglo-American Oil Co., Ltd.—Petroleum and petrol	684

The following tenders have been accepted for annual supplies to the electricity department:—

Sloan Electrical Co.—Arc lamps, carbons	£71
Dussek Bitumen Co.—H.T. joint-box compound	16
W. T. Glover & Co.—Fuse wire	

The following tenders have also been accepted :—

Lancashire Dynamo and Motor Co., Ltd.—40-H.P. slow-speed motor to drive combined air compressor at the electricity station, £131.

Thos. Wragg & Sons, Ltd.—1,500 yd., three-way stoneware conduits, 1s. 11½d. per 2 ft. 6 in. length.

J. Chapman & Sons.—Erection of transformer sub-station in Pump Street. £435.

Bertram Thomas.—Main traction switchboard, £1,517.

Southampton.—Messrs. Siemens Bros. Dynamo Works, Ltd., have obtained a contract from the Harbour Board for Wotan, tantalum and carbon lamps, and glassware, for the ensuing 12 months.

Swindon and Highworth.—The Guardians have accepted the tender of Messrs. J. Lott & Sons for six months' supplies of electric cable, flexible electric cord, and Phlatta switches.

Trimdon.—The P.C. has accepted the tender of Reid, Ferens & Co. for poles, brackets, cables, &c., for public lighting; and that of Walter Scott, Ltd., of Newcastle, for the electrical supply.

Wakefield.—The B. of G. has appointed Mr. W. Robb to supply electrical appliances required during the ensuing six months.

York.—The General Electric Co., Ltd., have secured the contract for Osram metal-filament lamps required during the ensuing year by the Corporation.

FORTHCOMING EVENTS.

Institution of Electrical Engineers (Newcastle Local Section).—Friday, April 3rd. At 7 p.m. At Hugh Bell School, Middlesbrough. Address on "Ozone," by Mr. E. L. Joseph.

(Manchester Local Section).—Tuesday, April 7th. At 7.30 p.m. At the University (Physical Laboratory). Paper on "Current-Limiting Reactances on Large Power Systems," by Messrs. K. M. Faye-Hansen and J. S. Peck.

(Yorkshire Local Section).—Wednesday, April 8th. At 7.15 p.m. At Philosophical Hall, Leeds. Paper on "The Bonecourt Boiler," by Mr. C. D. McCourt.

(Birmingham Local Section).—Wednesday, April 8th. At 7.30 p.m. At the University, Edmund Street.

Royal Institution of Great Britain.—Friday, April 3rd. At 9 p.m. At Albemarle Street, W. Paper on "Further Researches on Positive Rays," by Prof. Sir J. J. Thomson, F.R.S.

Saturday, April 4th. At 3 p.m. Paper on "Recent Discoveries in Physical Science," by Prof. Sir J. J. Thomson, F.R.S.

Association of Engineers-in-Charge.—Saturday, April 4th. Bohemian Concert.

Wednesday, April 8th. At 7.30 p.m. At St. Bride's Institute. Paper on "Intercommunication Telephones," by Mr. A. F. Cannon.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 4th. At 2 p.m. At Newcastle-upon-Tyne. General Meeting.

Salford Technical and Engineering Society.—Saturday, April 4th. At 7 p.m. At Royal Technical Institute, Peel Park. Paper on "Mechanical Ventilation," by Mr. M. Sutcliffe.

London Association of Foremen Engineers.—Saturday, April 4th. At 7 p.m. At Cannon Street Hotel. Paper on "The Heating of Factories and Workshops," by Mr. A. H. Barker.

Society of Engineers.—Monday, April 6th. At 7.30 p.m. At Institution of Electrical Engineers, Victoria Embankment. Ordinary Meeting.

Institution of Mechanical Engineers (Graduates' Association).—Monday, April 6th. At 8 p.m. At Storey's Gate, S.W. Paper on "Chains," by Mr. W. Clewes Garner.

Illuminating Engineering Society.—Tuesday, April 7th. At 8 p.m. At the Royal Society of Arts, Adelphi. Discussion on "The Lighting of Railway Carriages and other Public Vehicles," opened by Mr. E. Kilburn Scott.

Institution of Civil Engineers.—Tuesday, April 7th. At 8 p.m. At Great George Street, S.W. Ordinary meeting.

Rontgen Society.—Tuesday, April 7th. At 8.15 p.m. At Institution of Electrical Engineers, Victoria Embankment. Paper on "The Energy of the Rontgen Ray," by Dr. R. T. Beatty.

THE ELECTRICAL ENGINEERS

(LONDON DIVISION).

Commanding Officer—Lieut.-Col. H. M. Leaf.

The following orders have been issued for the current week :—

Monday, April 6th.—"A" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Tuesday, April 7th.—"B" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Wednesday, April 8th.—Recruits only. Recruit instruction, 7 to 10 p.m. Rating examination for all Companies, 7 to 9.30 p.m.

Thursday, April 9th.—"C" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Friday, April 10th, to Monday, April 13th, inclusive.—Headquarters will be closed for the Easter Holidays. Business of an urgent nature will be attended to on Saturday, the 11th inst., from 10 a.m. to 12 noon.

(Signed) F. R. Holt-White, Capt. R.E., Adjutant,
For Officer commanding L.E.E.

NOTES.

The 25 Club.—The next dinner of this club will be held at the Connaught Rooms, Great Queen Street, London, W.C., at 7.15 for 7.30 p.m., on Wednesday, April 22nd.

Institution and Lecture Notes.—The Association of Electrical Station Engineers.—We have received a copy of the printed rules of this Association. The constitution and objects of the organisation are described and full rules appear relating to membership, government of the Association, executive Committee, their election, powers, and duties, the general secretary and his duties, the funds, branches, &c. Those interested in the movement, but not yet in it, can find all the information they require in this booklet of 24 pages. Secretary, Mr. W. J. Ebben, 41, Warren Road, Leyton, London, N.E.

Manchester Association of Engineers.—At the annual general meeting of the Association on Saturday, Mr. E. G. Hiller was elected president in the place of Dr. Edward Hopkinson. The annual report of the Council showed steady progress. The number of members on the roll is 647, and there was a surplus of receipts over expenditure for the year of £251, and a net cash balance of £6,547.

Association of Engineers-in-Charge.—On Thursday last week the Ponder's End, Middlesex, Works of the Edison & Swan United Electric Light Co., Ltd., were visited by over 100 members of the Association and their lady friends. Demonstrations and regular work were carried on during the tour, and explanations were given of the various processes by the most experienced members of the staff. In addition to carbon and metal-filament lamps, the visitors were shown the complete manufacture of holders, switches, plugs and other electrical accessories, high-tension switchgear, electric fans and heating apparatus, and iron and brass castings. Tea was served, during which the chairman of the Association's Education Committee moved a vote of thanks for the cordial reception of the visitors, and Mr. E. Gimingham briefly replied on behalf of the directors and staff.

Institute of Locomotive Engineers.—In connection with the proposed London Goods Clearing House scheme, Mr. Louis Rottenburg, a director of the New Transport Co., Ltd., read a paper before the Institute on Saturday last, on "Locomotive Costs in Relation to Total Cost of Railway Transport."

Association of Mining Electrical Engineers.—At a meeting of the Notts. and Derbyshire branch at Nottingham, on Saturday, two papers were discussed, one by Mr. F. Church, Tibshelf, on "The Breakdown of a D.C. Motor Armature," and the other by Mr. H. J. Wroe, of the London branch, on "The Electric Pumping Plant at Tilmanstone Colliery."

On Saturday last 50 members of the East and West of Scotland branches visited the Breich pit of the Pumpherston Oil Co., where there is in operation an electrical winding set of the newest type. The winder, which is of the Siemens-Ilgner type, has been in operation for nearly a year. At present it is running at little more than half load, and the expectation is that when it is loaded to its full capacity the results will be still better. In the course of the afternoon the party were entertained to luncheon. Mr. James Caldwell, who presided, said he would not recommend the winding set for a small pit with an output of, say, 300 tons a day, but for a large pit, with an output of 900 tons, where it was possible to generate their own electricity, such an installation as they had at the Breich pit would pay in the long run.

Institution of Electrical Engineers.—The following are the Council nominations (in *italics*) for election to the Council for the year commencing October 1st, 1914. Members whose names are printed in roman type remain in office :—

President (one vacancy).—*J. F. C. Snell.*

Vice-Presidents (two vacancies).—*J. S. Highfield, C. H. Wordingham*, W. Judd, C. H. Merz.

Honorary Treasurer (one vacancy).—*R. Hammond.*

Ordinary Members of Council.—Members (six vacancies).—*Prof. B. Hopkinson, F.R.S., G. W. Partridge, W. H. Patchell, W. Ll. Preece, G. S. Ram, W. Slingo, A. A. C. Swinton, W. B. Woodhouse*, R. A. Chattock, F. Gill, Dr. A. Russell, W. Rutherford, A. H. Seabrook, Roger T. Smith.

Associate Members.—F. E. Berry, Captain E. O. Henrici, R.E., A. W. Martin.

Associates.—A. B. Anderson, E. Russell Clarke, A. M. J. Ogilvie, C.B.

At the meeting of the Birmingham Local Section, on Wednesday last, a paper by Messrs. K. M. Faye-Hansen and J. S. Peck, was read by Mr. H. K. Faye-Hansen on "Current-Limiting Reactances on large Power Systems." The discussion was closed.

Royal Institution.—The following are among the Lecture arrangements after Easter :—Dr. Walter Wahl, two lectures on "Problems of Physical Chemistry : (1) Study of Matter at High Pressures ; (2) Structure of Matter at Low Temperature (experimentally illustrated)." Prof. Silvanus P. Thompson, two lectures on "Faraday and the Foundations of Electrical Engineering."

On March 27th, Mr. P. Schilowsky gave a lecture on his experimental gyroscope.

Appointments Vacant.—Resident engineer for wireless telegraph station in Egypt (£50 month), Imperial wireless chain : shift engineer for Ilkeston power station (35s.), for Derbyshire and Nottinghamshire Electric Power Co. ; electrical engineer and gas manager (£350), for Malvern U.D.C. ; shift engineer (£156), for St. Ann's power station, Nottingham. Particulars are given in our advertisement pages.

(*Continued on page 583.*)

The 2,400-Volt Direct-Current Electrification of the Butte, Anaconda and Pacific Railway, U.S.A.

(*Concluded from page* 540.)

The 1,200-volt generators in the sub-stations are provided with heat-proof insulation, and owing to their unusually good commutating characteristics, will carry three times normal load for periods of five minutes, as well as the usual 50 per cent. overload for two hours.

An automatic voltage regulator is used to maintain an approximately constant voltage at the terminals of the motor by power-factor regulation. The motors are protected against overload by inverse time-limit relays, which are set to open at four times normal load. These relays have been adjusted to open under sustained overload in about two seconds, and upon short-circuit their action is practically instantaneous.

Excitation for the two generating units in each sub-station is obtained from two induction motor-driven sets, rated at 50-KW. each at 125 volts. One set is used for supplying current to the synchronous motor fields and is controlled by the automatic voltage regulator. The second unit supplies current to the separately excited fields of the direct-current generators.

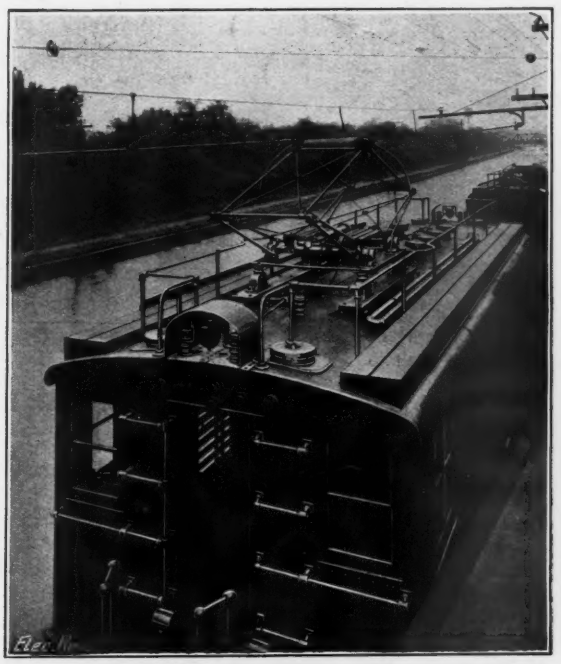
The 2,400-volt switchboards for controlling these sets are similar to the standard 600-volt types, with increased insulation and special provision for interrupting the 2,400-volt current. The circuit-breakers and switches are also arranged for remote control, and all apparatus on the panels is provided with ample insulation to ensure safety to operators.

The 2,400-volt circuit-breakers and switches are installed on separate panels above and behind the main panels, and are operated by connecting rods from handles mounted on the front of the main switchboard. These handles are similar in appearance, and to avoid confusion, the circuit-breaker handles are inverted. The breakers are equipped with special magnetic blow-outs and arc chutes, and provision is also made for automatically inserting a high resistance in the generator field at the same instant that the main circuit-breakers open, thus reducing the generator voltage.

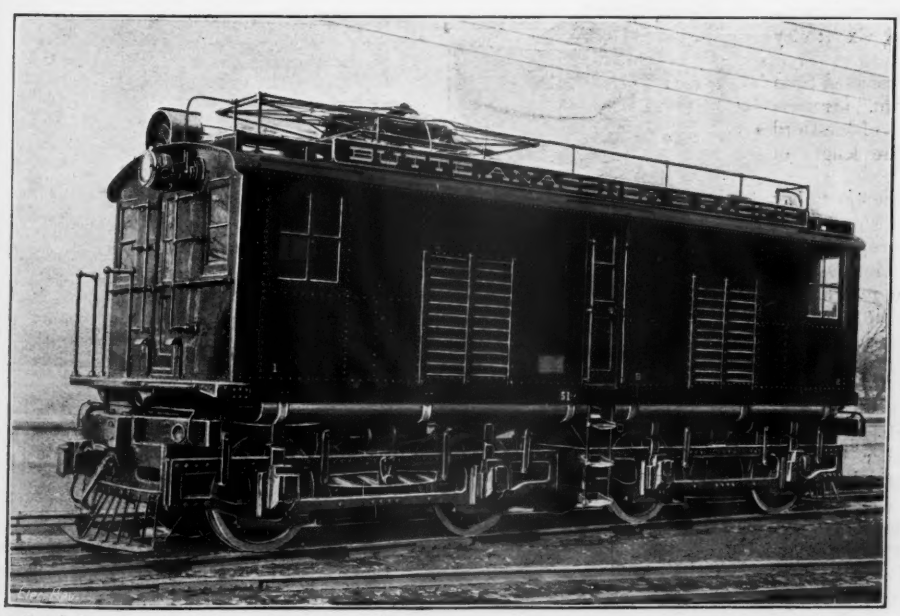
The alternating-current switchboard contains two panels for controlling the synchronous motors by means of remote-controlled solenoid-operated oil switches; two panels for the motor fields, and a panel for the automatic voltage regulator. These panels also contain other necessary instruments, including frequency and synchronism indicators, ammeters, wattmeters and relays.

The overhead construction for this system was especially designed to give the flexibility necessary for satisfactory operation of the pantograph trolleys used on the locomotives. The 4/0 grooved copper trolley used over all tracks is supported by an 11-point catenary suspension from a stranded steel messenger cable. Both side-bracket and cross-span construction are used, as required by the local conditions. There is a large amount of special work, on account of the many yards and sidings, and in one case 12 tracks are spanned. The cross-span construction used at this point is supported by a third pole between the eighth and ninth tracks. The hanger used on the straight-line construction is a rolled-steel strap looped over the messenger wire. This loop is closed at the ear, and the wire is clamped in place by a single bolt. Special pull-offs are used to increase the flexibility of the suspension.

The section breakers were designed for the 2,400-volt service, and at six points insulated crossings are necessary at the intersection of

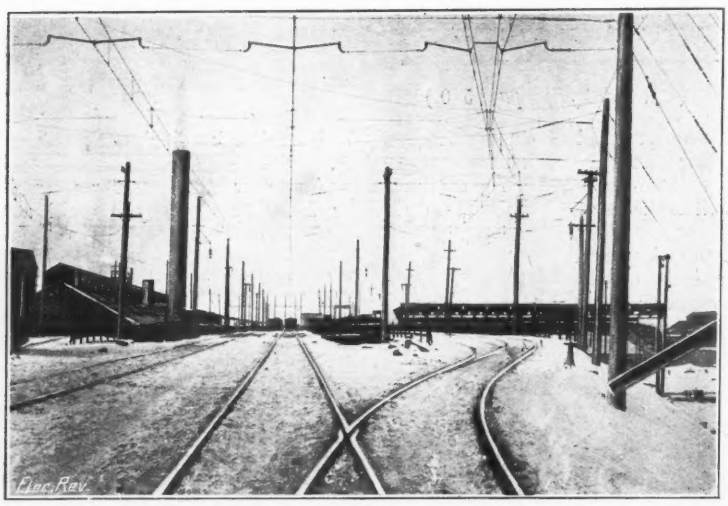


Roof Equipment of 2,400-volt d.c. Locomotive, Butte, Anaconda Railway.

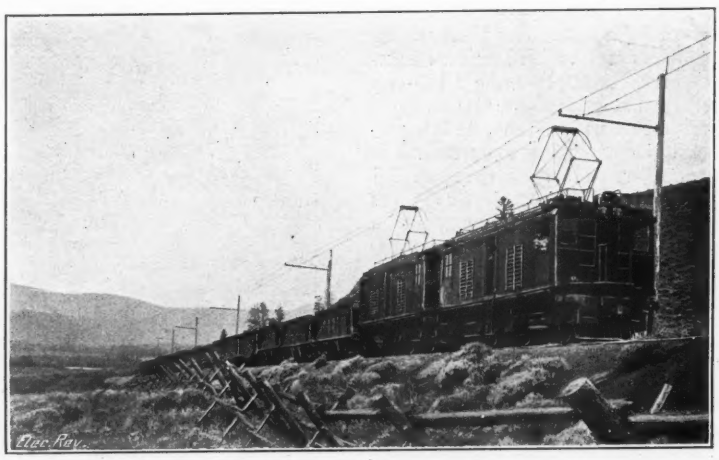


One of 17 80-ton 2,400-volt d.c. Locomotives on the Butte, Anaconda and Pacific Line.

the 2,400-volt trolley line with the 600-volt trolley line of the city system. On the main line a very simple-section insulator is used. This consists of paralleling the two trolley wires from the ends of each section at a suitable distance for insulation, so that the pantograph bridges the two circuits for a short distance, thus avoiding interruption of the power supply to the locomotive. The construction in the yards and sidings is simplified by paralleling the trolley from the side tracks for a short distance along the main line. This avoids the use of switch-plates or similar devices. At some of these junction points the pantograph engages as many as six trolley the wires.



Catenary Pull-offs in Switching Yard.



Double Locomotive hauling Freight Train, Butte, Anaconda and Pacific Railway.

The overhead lines are protected from lightning by 2,400-volt D.C. arresters installed on poles at intervals of one-third of a mile, along the entire length of system.

As regards the feeders, the 4/0 trolley is reinforced between the sub-stations with two 500,000 c.m. bare copper cables tapped to the trolley at intervals of 1,000 ft. A 4/0 negative return wire is also installed between Rocker and East Anaconda. This wire is carried on the trolley-poles, and is connected to the cross-bonds at intervals of 1,000 ft. The rails are connected by 4/0 bonds at every joint. The sub-stations are normally connected together by these feeders, allowing an interchange of current. In emergency either station can supply current to the entire system.

The locomotive equipment consists of 17 80-ton units (2,000 lb. to the ton), 15 for the freight and two for passenger service. The freight locomotives are geared for slow speed and are operated in pairs for the main line service. The maximum free-running speed is 35 M.P.H.

The two passenger locomotives are of the same construction as the freight units, but are geared for a maximum free-running speed of 55 M.P.H. A speed of 45 M.P.H. is obtained with three passenger coaches on straight level track.

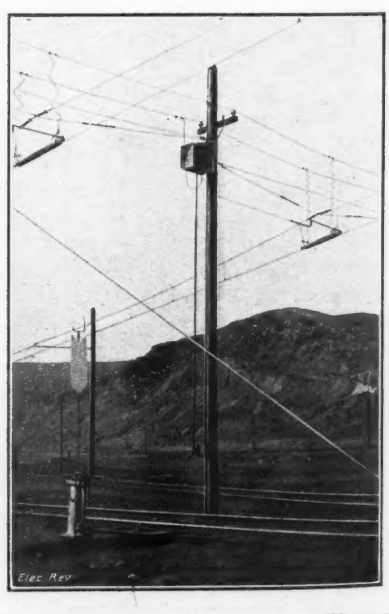
The continuous tractive effort of a single 80-ton freight locomotive is 25,000 lb. at 15 miles per hour. The maximum tractive effort for a period of five minutes is 48,000 lb., based on a tractive coefficient of 30 per cent.

These locomotives are of the articulated double-truck type, with all the weight on the drivers. The entire weight of the locomotive is carried on semi-elliptic springs suitably equalised.

The central channels forming a part of the underframe are enclosed and are utilised as a distributing air duct for the forced ventilation of the motors. The air is conducted through the centre pins, which are hollow, into the truck transoms and thence to the motors. The engineer's compartment at either end of the car contains the operator's seat, controller, air brake valves, bell and whistle ropes, ammeter, air gauges, sanders and other control apparatus within immediate reach of the engineer.

The contactors, reverser and rheostats, which are all located in the central portion of the cab, are mounted in two banks running lengthwise of the compartment, and are conveniently arranged for cleaning, inspection

Section Switch and Operating Lever.



Insulated Section at Crossing of 600-volt Trolley Line and 2,400-volt System.

and repair. All apparatus and circuits carrying 2,400 volts are thoroughly protected from accidental contact.

The motors are of the commutating-pole type, wound for 1,200 volts, and insulated for 2,400 volts. This motor was designed for locomotive service, and is provided with forced ventilation. The method of ventilation is similar to that of the well-known ventilated motors, but the volume of air circulated is increased by the use of an auxiliary blower mounted on an extension of a dynamotor shaft. The gear reduction on the freight locomotive is 4·84, and on the passenger locomotive 3·2. The double unit, 160-ton locomotive is capable of giving a continuous-sustained output of 2,100 H.P. The motors are connected to the driving wheels by twin gears similar to those used on the Detroit River Tunnel, Baltimore and Ohio, and the Great Northern locomotives.

The control equipment is of the Sprague-General Electric multiple unit type, operating the four motors in series and in series-parallel. Two 1,200-volt motors are permanently connected in series. The controller provides 10 steps in series, and nine in series-parallel. The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The transfer of circuits at this point is made by a special change-over switch, which is operated electro-pneumatically.

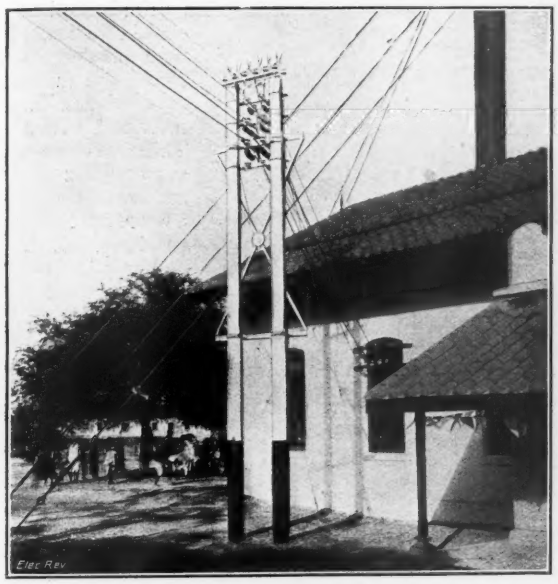
The 2,400-volt contactors are operated from the 600-volt control circuit, and are specially constructed to separate the 2,400-volt parts from the coils and interlocks which carry the 600-volt current. The necessary insulation is obtained by large clearances, and by the use of porcelain and mica insulation. The armature is connected to the contact lever by a wooden rod. The contacts, magnetic blow-out and arc chutes are also especially designed to rupture the 2,400-volt arc.

Locomotive Data.—The principal data and dimensions applying to the locomotives are the following: —

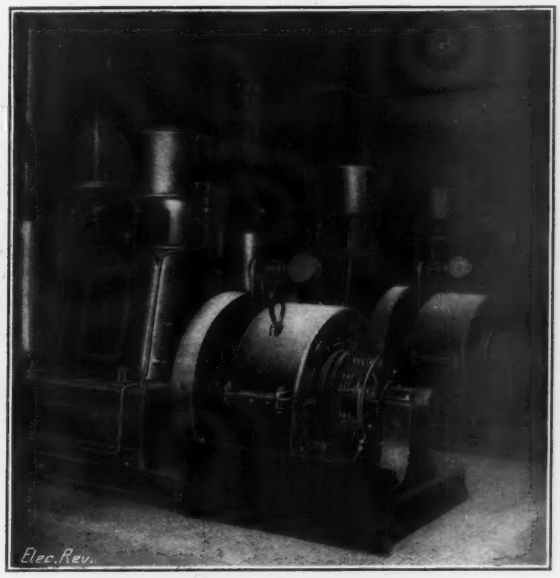
Length inside of knuckles	37 ft. 4 in.
Total wheel base	26 ft.
Rigid " "	8 ft. 8 in.
Track gauge	4 ft. 8½ in.
Total weight	160,000 lb.
Weight per axle	40,000 lb.
Wheels, steel tired	46 in.
Journals	6 in. × 13 in.
Gears, forged rims, freight locomotives	87 teeth
" " passenger locomotives	80 teeth
Pinions, forged, freight locomotives	18 teeth
" " passenger locomotives	25 teeth
Tractive effort at 30 per cent. coefficient	48,000 lb.
" " at one hour rating	30,000 lb.
" " at continuous rating	25,000 lb.

The locomotives have been maintained by the regular shop force with the assistance of one man experienced in electrical apparatus.

Current is collected by overhead roller pantographs, pneumatically operated and controlled from either engineer's compartment by an air valve. A 2,400-volt insulated bus-

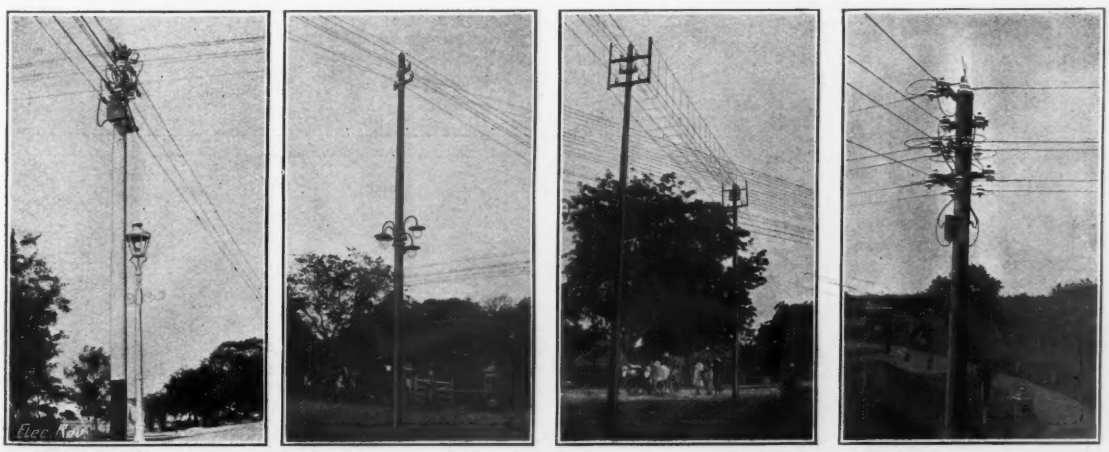


Double Terminal Pole, with Lightning Arresters, at Power Station.



Interior, showing Generating Plant.

Nagpur Electricity Supply Works. (See page 583.)

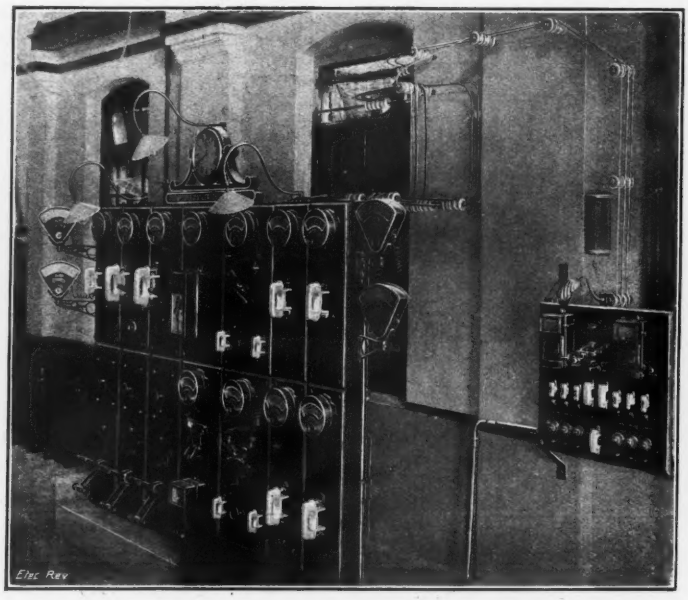


Pole Types Employed in Distribution Network, Nagpur Electricity Supply. (See page 583.)

line runs along the centre of the cab roof. These bus-lines are connected together by couplers between the two locomotives, so that current may be obtained from either one or two collectors. The air brakes are the combined straight and automatic type, and the compressor is of the 600-volt type, having a piston displacement of 100 cb. ft. of air per minute when pumping against a tank pressure of 135 lb. Radiating pipes are provided on the roof of the cab for reducing the temperature of the compressed air before it reaches the high-pressure cylinder.

For operating the control equipment and air compressor, and for lighting the locomotive and cars, 600-volt current is supplied from a 2,400 / 600-volt dynamotor installed on each locomotive. This machine is similar in construction to the 1,200-600-volt dynamotor, having two distinct sets of armature coils wound on the same core, and brought out to a commutator at each end. One of these windings is designed for 1,800 volts and the other for 600 volts, the two commutators being connected in series across the 2,400-volt circuit. The load current is taken from the 600-volt commutator.

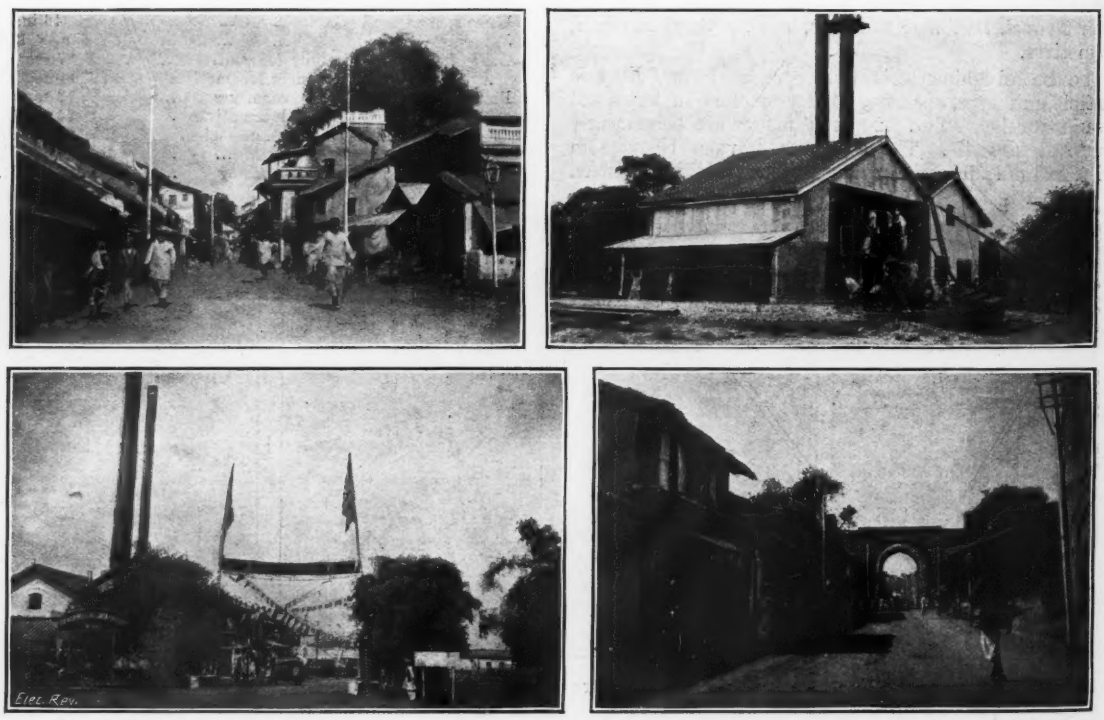
The mechanical load furnished by the direct connected blower supplies sufficient current in the series field windings to provide for the necessary excitation, so that no shunt windings are required. The blower which supplies ventilating air to the motor consists of a multivane fan mounted on an extension of the dynamotor shaft. It has a capacity of 7,200 cb. ft. per minute at 4-in. pressure.



Main Switchboard, Nagpur Electricity Works. (See page 583.)

Standard 600-volt lighting fixtures will be used on the cars, and each passenger and baggage coach will be wired for five groups of five lamps in series. The lights in each car will be controlled by a suitable master switch and fuse with snap switches in the individual circuits. Thirty-six-watt railway-type Mazda lamps are used, giving about 26 c.p. at 110 volts per lamp. Lighting current will be taken from a 600-volt train line-bus, which is connected to the dynamotor on the locomotives.

All of the passenger and baggage cars now used between Butte and Anaconda will be heated as well as lighted by electricity as soon as the equipment can be installed. Each car will be heated from a single heating unit installed underneath the car floor, and supplied from a 2,400-volt bus connected directly to the 2,400-volt bus on the locomotive. This unit will have a maximum capacity of 25 kw., and will be used to heat the air, which is distributed to different parts of the car by means of a small motor-driven blower. Cool air will be drawn into the insulated case enclosing the heating units from some point on the roof of the car. After passing over the heating coils the air will be carried through ducts under the floor of the car to radiators placed between alternate seats. The blower has a capacity of from 500 to 1,000 cb. ft. of air



Typical Views in Native City and of Construction and Opening of Electricity Works, Nagpur, India. (See page 583.)

per minute, and the motor is connected in series with the heating units.

In order to increase the range of the heating equipment to meet the requirements of varying temperatures, provision is made for connecting the coils to give a total consumption of 10, 15, 17·5, or 25 KW. The temperature of the car is regulated at all times by a thermostat.

All the apparatus for the electrification of this railway was furnished by the General Electric Co., of Schenectady, N.Y., U.S.A., whose allies in this country, the British Thomson-Houston Co., Ltd., of Rugby, have kindly furnished us with the foregoing particulars.

ELECTRIC SUPPLY AT NAGPUR, INDIA.

NAGPUR, the chief town of the Central Provinces and seat of the Central Provinces Government, with a population of 130,000, has recently been provided with an up-to-date electricity supply undertaking.

In 1911, with the assistance of Messrs. Crompton & Co., Ltd., the Nagpur Electric Light and Power Co., Ltd., was formed, with a native directorate and a capital of 5 lacs of rupees; Messrs. Crompton transferred the electric lighting licence which they had obtained to this company, remaining the contractors for the plant and installation.

The undertaking was formally opened by Sir Benjamin Robertson, the Chief Commissioner of the Central Provinces, in November last.

A brick power house structure has been erected, which, in addition to engine and boiler houses, also contains the offices of the company.

The plant installed includes one 50-KW. and two 100-KW. Crompton shunt-wound multipolar dynamos, fitted with interpoles, and wound for 450-550 volts, which are driven by direct-coupled Belliss compound non-condensing engines. The smaller engine is of 75 B.H.P., with a speed of 575 R.P.M., and the larger ones develop 150 B.H.P. at 475 R.P.M.

There are also installed two C.M.B. balancers, each to deal with an out-of-balance of 40 amperes, and a 14-panel Crompton switchboard in black enamelled slate containing the requisite switchgear and instruments for generator and feeder control.

Steam for the above plant is supplied from three Babcock and Wilcox boilers, each with a rated evaporation of 5,000 lb. of water per hour at 180 lb. per sq. in. pressure; each boiler is complete with an 80-ft. steel chimney, 3 ft. in diameter. Three direct-acting Weir steam feed pumps are provided, working in conjunction with a Worthington water heater.

The distribution system consists of bare copper wires carried on white porcelain insulators fixed to the steel cross arms of weldless tubular steel poles; the latter are painted white with a dark green base and set in a heavy concrete foundations, which were necessitated by the loose character of the soil. The positive and negative wires occupy the upper arms of the poles; the two wires on the bottom arm constitute the neutral of the three-wire system, and are linked together twice in every 50 yd. span to form a cradle under the upper wires. Two feeder boxes and 12 disconnecting boxes, fitted with switch fuses, have been provided in the mains network, the boxes being attached to the poles beneath the cross-arms and coupled to the line with insulated cable.

A special double-pole terminal has been provided at the power house, which carries lightning arresters and choking coils, and horn type arresters are fitted on all angle poles throughout the overhead system.

For the street lighting 40-watt metal lamps are employed, in iron brackets attached to the transmission poles at 12 ft. above the ground—singly, except at corners, where two or four-light brackets are used. Some 600 lamps are in use, divided up into groups of 40, controlled from a cast-iron watertight switch attached to the pole, and connected between the neutral and an independent street lighting wire carried along the top of the poles. The lighting wire is divided into alternate positive and negative sections through the switches.

Twelve miles of distributor and street lighting mains have been erected in the civil station, and 5 miles of street lighting wires only in the native city, where no private lighting distributors have as yet been installed, although these will be added in the future.

The lighting of the streets in the native city was rendered difficult by their narrowness, as in many cases they are not more than 12 ft. wide.

Native coal, costing Rs. 9-8-0 per ton, is used in the boilers, and the company's principal source of revenue is expected to be derived from the sale of energy for driving punkah fans, of which about a thousand are in use in offices and bungalows.

The price charged at present for lighting and fans is 6 annas per unit. The capital of the undertaking has now been fully subscribed, and by agreement the municipal authorities guarantee 4 per cent. interest on not exceeding 4 lacs of rupees for the first seven years, on condition that half the profits over 6 per cent. during that time revert to them, and that the company supplies and maintains the 600 street lamps for 11,000 rupees per annum during that time. The Chief Commissioner in the course of a speech at the inaugural ceremony, complimented the company on the excellent appearance and ornamental effect of the standards for the overhead wires.

In conclusion, we are indebted to Messrs. Crompton & Co. Ltd., for the particulars and views here given; the installation was carried out by them under the supervision of Mr. T. F. Raven, their local representative.

NOTES.

(*Continued from page* 578.)

Educational Notes.—A free scholarship of the value of £30, tenable at the Northampton Polytechnic Institute (London), is being offered to students of optics.

Smoke Abatement Inquiry.—Moving the second reading of the Smoke Abatement Bill in the House of Lords on Tuesday last week, Lord Newton said that under present conditions London received only one-third of the winter sunshine; the annual sootfall in London was 76,000 tons, and the damage cost at least 9 millions a year. Lord Curzon stated that as the result of legislation in India, in less than three years the emission of black smoke from factory chimneys at Calcutta had been reduced by over 80 per cent. Equally good results were obtained at Bombay. The Local Government Board agreed to appoint a Departmental Committee of Inquiry, of which Mr. Russell Rea, M.P., will be chairman.

Dinners and Socials. — The employés of Messrs. Anderson & Munro, Ltd., Glasgow, held their annual whist drive and dance on Friday evening, March 27th, in the Burlington House. There were about 60 couples present, and a most enjoyable evening was spent. The whist prizes were presented by Mrs. Wright, the wife of the chairman, and Mr. Wright referred to the pleasure which it gave the directors to be present, and to the good fellowship which existed amongst all grades. We understand that the firm have at present a very large amount of work in hand.

The employés of the Perth Corporation Tramway Department held their ninth annual social and dance recently, ex-Bailie Calderwood, convener, presiding.

The staff of the Willesden Electricity Department held their second annual dinner on March 14th, at Kilburn. Councillor H. Davey Turner, chairman of the Electricity Committee, presided. Mr. A. W. Blake, chief engineer, responded to the toast "Our Chief."

Mr. A. C. Cramb, borough electrical engineer, presided at the annual dinner of the Croydon electricity works staff, held recently. He proposed the "Corporation of Croydon," and the Mayor responded. He next gave "The Chairman and Members of the Electricity Committee," and Mr. Alderman Miller, who responded, referred to the fact that, as chairman of the Electricity Committee, he had just come of age. The toast "Our Engineer" was proposed by Mr. W. Burr, and suitably replied to by Mr. Cramb.

The Cryolite Athletic Association (London staff of the British Aluminium Co., Ltd.), maintained its quickly-gained reputation for enterprise by holding a most successful whist drive on March 28th, when about 160 members and friends spent an enjoyable evening. The president of the Association, Mr. W. Murray Morrison, was present, accompanied by Mrs. Morrison, who kindly

presided over the distribution of the prizes. The president referred to the satisfactory progress made by the Association since its formation six months ago.

The Witton Works of the General Electric Co., Ltd., held their twelfth annual dinner at the Old Royal Hotel, Birmingham, on Friday, March 20th, Dr. Railing being in the chair, supported by Mr. Railing, and the attendance numbered over 250. The works manager, Mr. W. H. Heaton, proposed the toast of the General Electric Co., Ltd.; responding, Dr. Railing emphasised the necessity for co-operation amongst the workmen and staff, which would benefit not only the firm, but also the workmen themselves. For his own sake, a man should apply himself to turning out apparatus of the highest possible grade of workmanship. It was only thus that they would be able to compete abroad with those large foreign electrical companies which made such strong bids for the world's electrical orders. The firm which failed to turn out the highest class of plant would go under, and its employés with it. As a mark of the interest which the directors of the General Electric Co. took in their employés, the board had just voted a sum of £10,000 for the erection of the new club house at Witton, which would be equipped on the most up-to-date lines. Mr. Railing supplemented Dr. Railing's remarks by announcing that the board were just completing arrangements for a pension scheme for G.E.C. employés. The healths of Dr. Railing and Mr. Railing were drunk to musical honours, and an entertainment followed, contributed mainly by the Witton staff, which included vocal and instrumental music and gymnastic turns.

Wireless Associations.—The formal opening of the Newcastle and District Amateur Wireless Association took place on March 21st, at 29, Ridley Place, Newcastle-upon-Tyne, the headquarters of the Association. Mr. N. A. Collard, the chairman of the Association, occupied the chair, and called upon Prof. W. H. Thornton, who was accompanied by Prof. H. Morris-Airey, both of the Armstrong College, Newcastle, to open the Association's premises. Dr. Thornton gave a brief outline of the history of wireless telegraphy, and at 4 p.m. transmitted the first message: "Full attendance, going strong," to the North-Eastern School of Wireless Telegraphy in Eldon Square, Newcastle, which replied: "Message received O.K. Wish you every success." Following the formal opening an exhibition of telegraphic (wireless and otherwise) apparatus was held, which remained open until 10 p.m. Among the exhibits was a very fine portable transmitting and receiving set kindly lent, together with other apparatus, by the Marconi Co., as well as apparatus by Messrs. A. W. Gamage, Ltd., London, and Messrs. S. Gillett & Co., Ltd., of Newcastle, and apparatus made and lent by members of the Association. The visitors numbered about 500. The Association has a membership of about 50. As before stated, Mr. N. A. Collard (departmental manager at Elswick Shipyard) is chairman, and Mr. F. S. Gibson (Eastern Telegraph Co., Ltd.), secretary, *pro. tem.*; these two, with Mr. G. H. Mann (principal), and Mr. N. Hall, of the Wireless School, form the Technical Committee. On application to the secretary at the Association's headquarters, amateurs in the North-East of England may obtain forms of application for membership and any other information they desire.

Birmingham Wireless Association.—The first Annual Exhibition of this Association was held on Thursday and Friday last week at Queen's College. There was an excellent attendance each evening. The platform in the Hall was occupied by four model aerials—Eiffel Tower, Nauen, Poldhu, and a reproduction of the "wireless compass" aerial, as applied to a ship. An interesting exhibit, from an historical point of view, lent by Dr. J. R. Ratcliffe, consisted of the first receiving set which was ever demonstrated in Birmingham. The detector is one of the original filings coherer type, and the set was sent to Dr. Ratcliffe by Mr. Marconi. The Marconi Co. exhibited the instruments used in connection with the "wireless compass," a multiple tuner and a magnetic detector. Amongst other notable exhibits were apparatus by Messrs. Gamage, the Ludgate Wireless Co., Graham & Latham, International Radiophones, Ltd., Dennison Watch Case Co., Western Electric Co., Marks & Co., Mr. S. G. Brown (Brown's relay), and Messrs. Beresford Bros. The annual meeting will be held on Monday next.

The I.M.E.A. Convention, 1914.—The preliminary programme for the 1914 Convention of the Incorporated Municipal Electrical Association has been issued. The headquarters are to be at the Grand Hotel, Birmingham, and the proceedings may be summarised as follows:—

June 15th.—Informal reception and concert in the evening at the Grand Hotel; distribution of tickets, badges, &c., which will not be posted as hitherto.

June 16th.—Presidential address by Mr. R. A. Chattock, and paper on "The Commercial Development of Electrical Supply in Towns of Moderate Size," by Mr. W. A. Vignoles, Grimsby; visits to works in the afternoon and annual dinner in the evening.

June 17th.—Meeting at Coventry; paper on "The Design and Operation of Modern Boiler-House Plant," by Mr. S. E. Fedden, Sheffield; visits to works at both Coventry and Rugby in the afternoon; reception and dance in the evening.

June 18th.—Meeting at Stratford-on-Avon; paper on "The Standardisation of Tariffs." by Mr. J. H. Bowden, Poplar; visits to Warwick Castle and Kenilworth in the afternoon; open-air fête and concert, Botanical Gardens, in the evening.

June 19th.—Annual business meeting; election of officers, &c.

June 20th.—Proposed visit to Worcester.

Information regarding the Convention can be obtained from the Secretary, I.M.E.A., 28, Bedford Square, W.C.

An "Information Bureau."—The zeal of our daily Press in the dissemination of intelligence is one of its most admirable characteristics; it sometimes, however, involves the arrogation of an inexhaustible store of knowledge, universal in its range and infallible in its wisdom, an assumption which is not invariably justified by the facts. Our very "live" contemporary, the *Evening News*, of course, is without the scope of these remarks, but even Jove sometimes nods, and we may be excused for drawing attention to a recent item in the "Information Bureau" which it conducts.

The query related to the erratic behaviour of a watch, which was said to be magnetised, though the owner had not been near any electrical machinery (but does he never travel on a tramcar?) The reply stated that this was not a necessary condition—"A 'short-circuit' within a short distance of the watch will often produce the result." It is well, therefore, when short-circuits are knocking about, to leave your watch at home. "The hair-spring when thus magnetised sticks to the balance, or is attracted to the escape wheel if either is made of steel, just as a piece of steel is attracted by a magnet." We like that "either." Both being, as a rule, pieces of steel, and both when magnetised being magnets, this is not improbably correct, and it is not surprising that under such circumstances the watch "either stops altogether, or commences to behave in a most erratic fashion." The recommendation is, quite properly, to have it demagnetised by a watchmaker. Unfortunately, the writer adds the following astounding paragraph:—

"There are on the market many non-magnetic watches which are unaffected by electricity, but if you are in the vicinity of electrical machinery while wearing an ordinary watch, a precaution usually effective is to wrap the watch in a silk handkerchief."

It is quite true that non-magnetic—and other—watches are unaffected by electricity; but although silk is a good electrical insulator, we are not aware that it insulates magnetism. The serene confidence of the writer, who declares that this precaution is "usually effective," commands our admiration. Under the circumstances, we hardly dare venture to suggest that it would be well, in answering such a question, to obtain the advice of someone who really knows something about the subject—a Boy Scout, for example.

Electrical Engineers' Price Book.—"Erg" writes: "Can any of your readers suggest a really reliable pocket price-book, dealing specially with the electrical engineering industry? During the course of my business I am constantly requiring approximate figures for cables, lamps, generators, A.C. and D.C. motors, gas engines, storage batteries, and a thousand and one other things. In the absence of a really reliable price book, I have to write to the various manufacturers, thus wasting much valuable time and disappointing innumerable commercial representatives, who always want to 'follow up' such inquiries."

So far as we know, there is no such pocket-book in print.

Inquiries.—Makers of tin binding clips for armatures, in Birmingham; soluble mica for filling gaps in the mica segments of commutators; machinery for making small sizes of lead covering for insulated wires; and British makers of "duplex metals" (copper-clad steel), are asked for. Particulars of a simple method of creosoting poles in the tropics are wanted by a reader.

For Sale.—Maidstone Corporation has for disposal by tender a quantity of steam piping and valves. The goodwill, stock-in-trade and plant of an electrical contracting and mill furnishing establishment in Lancashire are to be sold by private treaty. Particulars are given in our advertisement pages.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Heston and Isleworth have decided to revise the salaries of the employés at the Electricity Works. This proposal will have the effect of raising the wages bill by £70 per annum, and fixes the engineer's salary at £162 10s., rising to a maximum of £200; the clerk's at £110 (maximum, £130), and the shift engineer's at £8 per month, rising £1 a year to £10.

The Shipley District Council has advanced the salary of the electrical engineer (Mr. W. Redman) from £175 to £210 per annum.

Keighley T.C. has been recommended to increase the salary of Mr. H. Webber, borough electrical engineer, from £300 to £400 a year.

Mr. G. H. Bellwood, assistant electrical engineer to the Wishaw Corporation, has been appointed mains superintendent to the Rawtenstall electricity undertaking.

Mr. A. Redfern, assistant electrical engineer at Darlington, who is leaving to take up another position, has been presented by the staff with an oak writing desk.

Mr. J. A. Robertson, borough electrical engineer of Greenock for the past 10 years, has been selected by the Electricity Committee at Salford, for the appointment of city electrical engineer, Mr. Richardson having decided to remain at Dundee.

Tramway Officials. — The Highways Committee of the London County Council recommends that Messrs. M. H. Bates, D. Brown, W. Munro, H. Davidson, T. R. Ierland, and A. B. Cox, assistants in the fourth class, section (*a*) in the tramways department, be promoted to the third class at the commencing salary of £160 a year as from April 1st, 1914.

General.—The Stalybridge, Hyde, Mossley and Dukinfield Joint Tramways and Electricity Board has decided to advance the salary of Mr. F. Schofield, commercial manager, by £50 per annum.

Mr. O. Barnes has been presented with an electric candelabrum, in recognition of his services as chairman of the Electricity Committee of the Atherton District Council.

Mr. G. S. Corlett, for 22 years managing director of the Corlett Electrical Engineering Co., Ltd., of Wigan, has just severed his connection with the company, and will in future devote himself exclusively to electrical consulting work. The company will continue to carry on the same class of business as before, with the exception of the consulting department, which has been entirely taken over by Mr. Corlett, whose address is Midland Bank Chambers, Wigan.

Mr. H. C. Crews, M.I.E.E., consulting electrical engineer, of Manchester, has opened a branch office at 19, King Edward Street, Macclesfield; Telephone No. 219.

Obituary.—The *Review of the River Plate* refers to the death of Mr. George Newbery, "Argentina's foremost aviator, which occurred on Sunday last in Mendoza while he was making a short flight with a passenger. He was the son of the late Dr. Ralph Newbery, and was educated in Buenos Ayres and the United States, and took up electrical engineering as a profession. After his return from college he became chief electrical engineer to the Argentine Navy, and after holding one or two other positions, he was appointed, about 10 years ago, head of the public lighting department of the Buenos Ayres Municipality. He died at the early age of 38 years."

On March 23rd, Prof. G. M. Minchin, F.R.S., died at Oxford, at the age of 68. He was known principally in connection with mathematics, but in his younger days he carried out a good deal of research on photoelectric phenomena, with a view to transmitting pictures by telegraphy.

The death is announced of Prof. J. H. Poynting, F.R.S., Professor of Physics at Birmingham University, at the age of 62; he was a distinguished mathematician, and was noted for his experimental researches in connection with the determination of the mean density of the earth.

CITY NOTES.

Metropolitan Electric Tramways, Ltd.

The annual meeting was held on March 25th, at Electrical Federation Offices, Kingsway, under the presidency of Mr. E. Garcke.

In proposing the adoption of the report (see Elec. Rev., page 545), the Chairman said that on those occasions he had usually made a statement in relation to the general traffic problems in London, but since the last meeting upwards of 93 per cent. of the shares of the company had been converted into capital of the London and Suburban Traction Co., and as the majority of the shareholders therefore were now interested in that concern he thought his duty would be discharged if he simply explained the accounts and left explanations with regard to policy to be settled by the directors of the London and Surburban Co. The conversion of the shares had produced some marked changes in the position of the company. The policy was now quite properly and necessarily directed by the board of the London and Suburban Co.; but the duties and responsibilities of the officers of their company had been largely increased. They had now taken over, in addition to the management of the operations of that company's tramways and power business, the tramways of the London United Tramways Co. and of the Metropolitan Omnibus Co.; in addition to attending to the affairs of the controlling company. He was glad to be able to bear testimony to the fact that the enormous accession of work and responsibility had been fully met by the staff—in fact, it had been a matter of surprise to note how very ably Mr. Devonshire, the managing director, Mr. Barber, the secretary, and the other officers had shouldered the additional duties and responsibilities which had been suddenly thrown upon them. Another result, which had been produced, was marked economy in the administration. The figures did not fully display all those economies, but when he told them that the item of office and general expenses, which in 1912 was £8,173, was last year reduced to £6,253, they would see the reduction which had been effected in expenses. On the other side, however, the dividend on the ordinary shares had fallen from 5½ per cent. to 3 per cent. He wished to assure them that the reduction of profit was not the result of the consolidation of the interests of the two companies, but was in spite of the amalgamation. The underlying cause of the fall in their profits was, undoubtedly, the motor omnibus competition; but a large part of the damage which had been caused to the tramway revenue had been made good to the shareholders who had converted their shares into capital of the London and Suburban Traction Co., because they had participated in the profits of the motor omnibuses. The preference shareholders who had converted, had for the past year received a return of £5 6s. per cent. instead of 5 per cent. as formerly, and the ordinary shareholders who had converted had received 5 per cent. as compared with 5½ per cent. for the preceding year; while those ordinary shareholders who had not converted had received only 3 per cent. The result was better all-round than would have been the case if the consolidation had not taken place. If they had had unsympathetic competition the result would have been very different. They hoped for better results in the future for the divergent interests were now in course of being adjusted, and wasteful competition would, they hoped, be still further reduced to the benefit of the public and to the advantage of the company. The receipts on the tramways had improved by over £15,000, but on the other hand, running expenses had increased by some £16,000 or £17,000. It was satisfactory to know that the revenue from dividends and interest in respect of their holding in the North Metropolitan Electric Power Supply Co., showed a steady improvement. For the past year the dividend amounted to £48,600, against £35,800 in the preceding year. Their through-running arrangements with the L.C.C. had been extended much to the advantage of the travelling public, but he was sorry to say that they had not benefited very largely by these arrangements. The effect had been that a larger proportion of passengers from their district had travelled over the lines of the L.C.C. than before, but the number of passengers they had brought into their district had not correspondingly increased. They were not proceeding with their powers for the construction of tramways in the Watford and Bushey district. The reasons were that, owing to changed conditions, the route was not likely to prove as profitable as they thought likely many years ago when the powers were obtained. The reason why they were not carried out at that time was due to difficulties about street widening, and there was a gap between the Bushey line and their Cricklewood lines and they had never been able to overcome these difficulties. Taking everything into consideration they thought that the better policy would be not to go on with the construction of those lines, and so by an agreement with the L.C.C. and the local authorities concerned, it had been decided to abandon them, but their own 'buses were serving the district adequately.

Mr. J. Devonshire seconded the motion and the report was adopted.

Slough and Datchet Electric Supply Co., Ltd.

The capital expenditure during the year 1913 was £6,315, making the total £64,346. The additional expenditure chiefly represents the installation of a 400-k.w. steam turbine, and a water cooling tower. The following table shows the progress of the company, the equivalent of 1,716 additional lamps of 8-c.p. having been connected last year:—

Year.	Lamps and Motors connected.	Units Sold.	Revenue.
1911 ...	24,115 ...	426,136 ...	£6,775
1912 ...	25,914 ...	819,733 ...	£8,546
1913 ...	27,630 ...	842,389 ...	£8,900

The total net profit available for distribution is £4,993, out of which the directors purpose setting aside £1,250 to the depreciation fund, bringing it up to a total of £7,305. Out of the remaining net profit a dividend of 6 per cent., less income tax, has been declared, and £377 is to be carried forward.

Oriental Telephone and Electric Co., Ltd.—The directors recommend, subject to final audit, dividends at the rate of 6 per cent. per annum (less income-tax) on the preference shares for the December half-year, and a final dividend of 6 per cent. on the ordinary shares (free of income-tax), making a total of 10 per cent. for the year. The transfer books will be closed from April 14th to 27th.

Canadian Bell Co.—The annual report of the Bell Telephone Co., of Canada, shows for 1913, an increase of 16 per cent. in gross earnings, and of 17 per cent. in net earnings over 1912. The total revenue was $8,850,448, and the balance $1,793,522, of which $1,289,790 was distributed, at the rate of 11·124 per cent. on the stock. The total investment of the company is now $35,572,902.—*Telephony.*

Marconi Wireless Telegraph Co., of America.—According to the New York correspondent of the *Financial News*, the annual report of this company, which covers a period of 11 months to the end of December, shows a surplus of $178,000. The company has received many inquiries from officials of railroad companies for equipment, and the directors announce that they expect to build up a substantial business in the supply of wireless installations for trains. It is declared that profits are assured by the Government orders for the coming year.

British Aluminium Co., Ltd.

Mr. A. W. Tait presided on March 27th at the annual meeting of the above company, held at Winchester House, E.C.

The Chairman, in moving the adoption of the report (see Electrical Review, p. 545), said that the trading profit, etc., for the year as mentioned in the report was £268,720, as compared with £194,824 for the previous year, an increase of £73,896. These results were satisfactory, and were far and away the best which the company had ever produced since its inception in the year 1894. The increase in the net profits was entirely due to trading, and not to any extraneous reasons. It was accounted for by an increase in tonnage, some economy in the cost of production, and also largely by an increase in price over that ruling in the previous year. He did not, however, wish the shareholders to form the impression that prices for aluminium during the past year were in any way abnormal. The price had only returned to a reasonable level after the severe depression of the last four or five years, which was brought about by the keen competition between the large producers and the relatively large difference between the productive capacity of the various works and the demand for the metal. This position had each year been gradually improved, and this was due to the fact that there had been no large increase in productive capacity, while all over the world there had been a considerable expansion in the demand for the metal. When they considered the uses to which aluminium could and should be put with advantage as compared to the metals which were at present employed, there was every reason to believe that this expansion would continue. Considerable development and missionary work had been done to open up new lines and uses for the metal, and the progress which had been made encouraged the continuation of this development work, which would in time mean a considerable increase in the annual consumption of the metal. There would and must be the usual periods of activity and depression, because no progress could be made in an absolutely straight line, and at present, in common with all other industries, there was a temporary set-back in the demand; but, in their opinion, it was only a matter of time before the position showed considerable improvement, and he saw no reason at present to anticipate that there should be any falling off in the results during the present year. The whole of the works had been operated satisfactorily during the year, and these operations had not been affected by any serious labour disturbances, either in their own business or in the general commercial world. Owing, however, to the general industrial prosperity which prevailed during the year, their cost was somewhat affected by the high prices of coal and the increased rates ruling for freights. There were, however, indications that during the present year these items would show a reduction. Additional plant had been installed at the Aluminium Works at Vigelands, Norway, which would have the effect of increasing the productive capacity of these works. In reporting the circumstances connected with the acquisition of these works from the Anglo-Norwegian Aluminium Co. at the last general meeting, he stated that the balance of the purchase price would be paid within a few months from that time. When he made that statement he expected that they would be able to accelerate the arrangements with regard to the payment of the final instalment, which was not due until this year, but, owing to legal necessities, this could not be carried out. A further payment in accordance with the contract was made during the year 1913, and the final payment would be made in June next. Owing to the large increase which had been made in the productive capacity of the company's aluminium works and the further increase which he had mentioned, it had become necessary for them to increase the capacity of their works for the production of alumina. Last year he mentioned that to provide for this in part the company had taken a one-half interest in the works of the Bauxite Refining Co. at Hebburn-on-Tyne, and while they were now obtaining a certain output from these works, that increase was not sufficient to provide for present, or immediate future, requirements. Lengthy investigations had been made as to suitable sites all over the United Kingdom, and arrangements had been finally completed for the acquisition of a site of about 38 acres at Burntisland, Scotland. The site was well situated, not only in respect of labour supply and shipping facilities—particularly to their works in Norway—but was also within a stone's throw of the Fife coalfields, which ensured an abundant and cheap supply of fuel, coal being one of the most important items in connection with the manufacture of alumina. These works, when complete, would provide not only for their present requirements, but also for their requirements for some time to come, and would allow them to have the necessary margin in case of temporary breakdown or stoppage at their other works. They would appreciate that increase in their productive capacity of aluminium must mean an increase in their capacity to manufacture the materials used for its production, and it had therefore been necessary to make arrangements to proceed with the extension of their works at Kinlochleven for the manufacture of carbon electrodes. The plans and specifications for these works had been prepared and the work had been begun, but they could not expect that either these works or the works for the production of alumina would be completed in the course of the present year. In order to ensure a large supply of bauxite, arrangements were completed in the early part of last year to take over from the Union des Bauxites a considerable tonnage of bauxite of good quality. This had now been done, and the material had been deposited upon land in the name of this company. This stock would be kept as a reserve and would only be used if and when required to supplement the supplies which they regularly obtained from their subsidiary company under existing contracts. It was important that this company with its large productive capacity should always carry a considerable reserve of raw material. The company's rolling mills at Milton, Staffordshire, had been kept employed up to their full capacity during the whole of the year, and arrangements were made for the acquisition of land and buildings at Warrington, Lancashire, for the erection of new mills. These mills had now been completed, and commenced partial work in the beginning of this month. The extension of this part of the company's business was desirable and necessary, not only from the point of view that it was profitable in itself, but it also enabled the company to find an outlet for a substantial portion of its production outside of the market for ingot metal, for which they were necessarily in competition with the other large producers. The demand for manufactured aluminium continued to grow in a satisfactory manner, and there was every reason to believe that the new works would be kept fully employed and that in time the extension of which they were capable would also be carried out. For the efficient operation of these works, it was necessary that the company should provide for its own power supply, and arrangements had been completed for the erection of a power house and the work was well in hand. In the meantime, arrangements had been made with adjoining works for a temporary supply of power until their own plant was available. With regard to the Orsières Power Scheme, there was nothing new to report. The works were being efficiently maintained and supervised, and no new development work was being carried out. The Martigny-Orsières Railway was in operation for general traffic, but the receipts obtained were only sufficient to meet operating expenses. The Chairman proceeded to deal with the various items in the balance sheet, and said that the profit for the year, after providing for the service of the prior lien debentures and debenture stock, and allocating sums to the depreciation and general reserve accounts, was sufficient to justify the directors in recommending the payment of the full dividend on the preference shares and a dividend at the rate of 5 per cent. on the ordinary share capital of the company. This was the first time that a dividend had been paid on the ordinary shares since the reconstruction of the company, and it was with great pleasure that the directors recommended this, while still making ample provision for reserves which were required for the general development of the business.

Mr. S. H. Pollen seconded the motion.

Mr. Poole complimented the Board on the way they had pulled the company round, and said that so long as they showed good results the shareholders would not mind paying them what looked like a liberal remuneration.

The report was then adopted.

Mr. R. W. Cooper, in proposing the re-election of the retiring directors, said the company owed a great deal of its recovery to Mr. Tait. In Mr. Romnel again they were fortunate, having one with a knowledge of the technique of the industry.

Mr. J. Taylor seconded the motion and it was carried.

South Metropolitan Electric Tramways and Lighting Co., Ltd.

The annual meeting was held on March 25th last, at Electrical Federation Offices, Kingsway, Mr. J. Devonshire, the managing director, presiding.

The Chairman, in proposing the adoption of the report (see Elec. Rev., page 547), said the result of the year's operations showed a surplus of £15,026 as compared with £15,493 in the preceding year, including £922 brought forward. That provided a balance available for distribution of £15,949. They proposed to place £5,000 to reserve, which was the same amount as last year, and to pay a year's dividend on the preference shares which would require £10,174, and leave £775 to be carried forward. They would remember that the chairman, who he was sorry to say was absent through ill-health, at the last meeting unfolded to the shareholders proposals for consolidating the interests of the company with those of the London and Suburban Traction Co., Ltd., by exchanging their holdings for fully-paid shares of that company. Those proposals were duly accepted by a very large majority of the shareholders of the company, and a circular was sent out last June informing them that the offer made by the London and Suburban Traction Co. had become binding. The exchange of shares had since taken place, the result of which was that the control of the company had now passed into the hands of the London and Suburban Traction Co.

Mr. E. Garcke seconded the motion which was adopted unanimously without discussion.

London and Suburban Traction Co., Ltd.

The annual meeting was held on March 25th, at the Holborn Restaurant, Mr. C. B. Stuart Wortley, K.C., M.P., in the chair.

In moving the adoption of the report (see Elec. Rev., page 546), the Chairman said that was the first annual meeting of the company, which existed not for the purpose of themselves operating transport and other public services, but for the purpose of controlling—and by controlling, harmonising—the work of certain companies which did operate such services. The company's function was to promote co-operation and to prevent waste. But it was none the less their business to satisfy the public. The public looked for regular, cheap and efficient services; and, so long as those were supplied to them, they had no reason to care whether it was competition or co-operation that had produced the efficiency. Those who had studied the circulars by which shareholders were invited to exchange their holdings in one or other of the subsidiary companies for London and Suburban Traction stock had doubtless got a fairly complete idea of the organisation and aims of the new company. It might, however, be convenient to survey, with more completeness and accuracy than was possible at previous stages, the field which the company occupied. The company held the following proportions of the issued share capital in the following operating companies, namely:—93 per cent. in the Metropolitan Electric Tramways, Ltd., 97 per cent. in the London United Tramways, Ltd., 100 per cent. in the Tramways (M.E.T.) Omnibus Co., Ltd., 99 per cent. in the South Metropolitan Electric Tramways and Lighting Co., Ltd., 29 per cent. in the Gearless Motor Omnibus Co., Ltd. Those holdings were in the company's direct ownership. He must, however, add that through their holding in the M.E.T. they were indirectly owners also of controlling interests in the North Metropolitan Electric Power Supply Co. and its subsidiary, the North Metropolitan Electrical Power Distribution Co., Ltd. They had thus acquired a share of the profits (in most cases they got practically all the profits) of seven different companies, which between them conducted two different classes of business, namely, tramway and omnibus services, and electric light and power supplies. The Metropolitan Electric Tramways, Ltd. was at present working 56¼ route miles of tramways and light railways mainly on the north side of London. By arrangement with the L.C.C. the company's cars and the L.C.C. cars provided mutual through-running services over certain sections of the company's system and the L.C.C. system. The Metropolitan Electric Tramways Co. had an important asset in the shares they held in the North Metropolitan Electric Power Supply Co. This was a statutory company incorporated in 1900 which supplied electrical energy in bulk over a supply area of 325 square miles in Middlesex, Hertfordshire and Essex. It supplied electricity for working the whole of the Metropolitan Electric Tramways Co.'s system. It also gave bulk supplies to various local authorities for lighting and power purposes. Its ordinary shares were all held by the Metropolitan Electric Tramways Co. and for 1913 they paid 12 per cent. or a sum of £42,000 to the revenue account of the Metropolitan Electric Tramways Co. It was, moreover, itself the holder of the whole of the share capital of a subsidiary company called the North Metropolitan Electrical Power Distribution Co., Ltd., which operated electric lighting orders in Barnet, Hertford, Enfield and St. Albans, and which paid for 1913 a 6 per cent dividend amounting to £3,000. The Metropolitan Electric Tramways results for 1913, including the results of the Power Supply and Distribution companies showed a revenue (including £604 brought in) of £539,850 and charges (including renewal reserve) of £487,568. The resulting balance of £52,282 was disposed of by paying a sum of £12,000 to reserve, a full preference dividend of £25,000, a 3 per cent. ordinary dividend of £14,230 and carrying forward £1,052. The London United Tramways had a system comprising 53½ miles of tramways in the counties of Middlesex, London and Surrey. It had in recent years suffered even more seriously than the Metropolitan Electric Tramways from competition. It nevertheless played a very important part in the transport business of greater London, and it was difficult to believe that that part would not increase in importance as London extended in the district that the company served. The company's next asset was their holding in the South Metropolitan Electric Tramways and Lighting Co., Ltd., which owned and worked 13 miles of tramways in districts immediately to the west and north-east of Croydon. The undertaking also operated a thriving and progressive electric lighting service in Sutton, Cheam and neighbouring areas. Next came the Tramways (M.E.T.) Omnibus Co., Ltd., in which they held the whole of the shares, and it was a fair inference that the satisfactory revenue obtained in 1913 would be largely increased in 1914. The company also had a small holding in the Gearless Motor Omnibus Co., Ltd. To sum up, the total traffic receipts of all the traction and omnibus undertakings to which he had referred, were £1,152,619. A total of 219,000,000 passengers were carried in 1913, and 37,000,000 units of electricity were sold. He could add little to the particulars of their own financial results given them in the accounts appended to the report. They had an income of £98,925 from their holdings in the subsidiary companies, and £6,309 from interest on money lent to some of those companies. Including sundry receipts their total revenue for 1913 was £105,370. Not being an operating company they had no operating expenses in the ordinary sense. Administration and general expenses accounted in all for £1,980. Interest on debenture stock was £8,094 and on loans £7,043. Their total expenses therefore amounted to £17,118. The disposal balance provided £79,655 for full interest at 5 per cent. on their preference shares and £8,597 for the carry over. They owed £71,750 to two of their subsidiaries, and were owed £143,250 by three others of them. This method of financing each other according to needs was equally favourable to the borrowing and the lending company. The borrowers paid a lower rate of interest than would be exacted from them by an expert market lender, while the lender received a higher rate than he could get by placing his surplus cash out on deposit. They had lately created £350,000 of 5 per cent. "A" debenture stock which they had sold on what they considered advantageous terms. With the proceeds of this sale, the particulars of which appeared in the prospectus of the International Financial Society, they would be able to pay off all their short-dated loans and provide working capital for the subsidiary undertakings. A paragraph in the report stated what hopeful prospect there was of substantially increased receipts from their investments in future years. To this he might add that the terms of the arrangement with those to whom they had sold the £350,000 of "A" debenture stock, was such that the whole sum would be paid off at the end of 20 years.

Mr. E. Garcke seconded the motion.

The Chairman, in reply to questions, said that their agreement with the L.G.O. Co., limited their M.E.T. 'buses to 350. They were discussing the question of competition with the L.G.O. Co., as they considered that to run empty or half-empty tramcars or omnibuses along the same lines of route was good neither for the public nor for the companies concerned. Regarding the appointment of a controlling authority for London traffic he thought they would all be agreed that it would not be fair to the existing companies if the power of licensing or regulating was given to any authority in London owning tramcars of its own. As an old Parliamentarian he was in favour of the Metropolitan police, which was the only authority which had jurisdiction for as great a distance as 15 miles from Charing Cross, being the traffic authority, for that body carried out its duties with tact and discretion.

The report was adopted.

London United Tramways, Ltd.

Mr. W. M. Acworth presided on March 25th over the annual meeting, held at Electrical Federation Offices, Kingsway.

In proposing the adoption of the report (see Elec. Rev., page 544), the Chairman stated that as most of the shareholders knew, more than 97 per cent. of the shares of the company, had been exchanged for shares in the London and Suburban Traction Co., which was now the operating company. With regard to the accounts there had been an increase in the gross traffic receipts of £5,662. In view of the severe nature of the motor-bus competition he thought they must regard that as satisfactory. On the other hand, owing to the increased cost of coal, and other material; exceptional expenditure on the permanent way and overhauling on their rolling stock, their expenses had increased by about £12,000, so that the net result showed a falling off in the profits of about £5,635. He thought, however, they might look forward to a reduction in expenses in the current year. Their coal contract had been placed at improved prices and the cost of material showed an easier tendency. The special overhaul of rolling stock was nearly through, and the charge on their reserve fund for cast-welding rail joints was completed. On the whole, his own opinion, for what it was worth, was that the company had touched bottom. They had had to face the competition with the electrified railways and more especially with motor omnibuses. That competition could not have been foreseen when the undertaking was originally started, but he thought that competition had done its worst, and while they were never likely to see the prosperity that was reasonably anticipated when their undertaking was started, the fact that they carried over 60 million passengers last year (a small increase over 1912), showed that there was still room for them and that their services met a real public need. It was with that feeling, that instead of feeling it imperative as in the previous four years, to ask them to carry the whole of the net revenue to reserve, they were able on that occasion to recommend a small dividend of 1 per cent. on the preference shares on account of the arrears for one year, 1908. While every care was taken to keep the expenses down to a minimum the directors felt that they had at all times the support of the shareholders in considering any reasonable modifications in regard to the rates of pay and hours of labour of their employees. Amongst other concessions made during the year was an increase in the rate of pay to conductors. In conclusion, he said that they could not yet say anything as to the proceedings between themselves and the L.C.C. in reference to the taking over by the Council of their lines in Hammersmith. The matter had been constantly before the directors during the past 12 months and they had given it most anxious and careful consideration, but nothing had yet been definitely settled.

Mr. J. Devonshire seconded the motion which was carried.

Liverpool District Lighting Co., Ltd.

The directors' report for the year ending December 31st, 1913, shows that the supply of electricity continues to make satisfactory progress, 5,101 lamps having been connected during the year. The total number supplied at December, 1913, was 40,810. The total quantity of electricity sold during the year was 504,247 units compared with 445,688 for the year 1912. The sales of electricity have, for the first time in any year, exceeded the half million units. A new engine and dynamo has been installed at the generating station at Waterloo, with a normal output of 500 KW. This increases the capacity of the generating plant from 630 KW. to 1,000 KW., after allowing for the removal of three old engines and dynamos which are now too small for economical use. The new plant will show considerable economy in fuel as compared with old conditions. The profits for the year, together with the balance brought forward from 1912, after payment of the final dividend for that year and the interest on the special account, leave an available balance of £4,446. Out of this an interim dividend has been paid at the rate of 4 per cent. per annum, and £1,125 set aside for depreciation, leaving a balance of £2,191, out of which it is recommended that a dividend be declared for the half-year ending December 31st, 1913, at the rate of 4 per cent. per annum less income-tax, amounting to £1,130, that £900 be placed to reserve, and that the balance of £162 be carried forward.

Mr. Holbrook Gaskell, deputy chairman, presiding over the annual meeting at Liverpool on Monday, said the past year had been a record one in more than one respect. The increase in units sold—58,000 units—had beaten last year's record of 54,000 units, which itself had been a greater increase than the previous five years added together. There was also a record in the matter of profits. Last year the increased profits amounted to almost 1 per cent. of the capital of the company. This year the increased profits had amounted to 1½ per cent. of the capital. The total profit for the year, after paying interest on bank overdraft, was £4,279, which represented 7·13 per cent. of the ordinary paid-up capital of the company. The directors had decided that the wisest policy was to build up a reserve fund to meet any contingencies that might arise, rather than pay a higher rate of dividend. They had therefore recommended the payment of a dividend of 4 per cent., with 1½ per cent. placed to reserve, after providing 2 per cent. for depreciation of plant and cables. The chief expenditure on capital account to be provided during the next few years was the continuous laying of new cables in the streets. It would be necessary to spend about £6,000 in this way during the next three years. Under existing conditions it was necessary for consumers who wished to adopt electric heating in their houses at the reduced rate of 1½d. per unit to go to the expense of installing separate wires and meter for this purpose, but the directors now had under consideration an alternative method of charging for the current used, which would allow consumers to attach radiators to the ordinary lighting wires, and still have the benefit of the reduced rate. For this purpose a fixed charge per annum would be made, which would vary in accordance with the size of the house, or the requirements of the tenant, all electricity consumed being charged for at 1½d. per unit.

The report and accounts were adopted, and Mr. T. A. von Sobbe and Mr. W. A. Coolison were re-elected directors.

British Westinghouse Electric and Manufacturing Co., Ltd.

The annual report for the year ended December 31st, 1913, states that since the last annual general meeting the scheme for the reduction of capital approved by the shareholders has been duly sanctioned by the Court, and the year's accounts are based thereon. The directors report a continued improvement in the business with an increased volume of work. The gross profit amounts to £223,103. From this there are deducted :—Depreciation on works, machinery, plant, &c., £44,100 ; redemption of 6 per cent. prior lien debentures, £6,728 ; interest on 6 per cent. prior lien debentures, £13,272 ; interest on 4 per cent. mortgage debenture stock, £49,654 ; expenses on surplus land and buildings, £2,856, leaving a net profit for the year of £106,494. This is appropriated as follows :—To general reserve, £50,000 ; to dividend on preference shares at the rate of 5 per cent., £50,000 ; carried forward, £6,494. The balance of £66,899 to the credit of profit and loss account at December 31st, 1912, was absorbed in the reduction of capital. As in previous years, a substantial amount for the maintenance of works and plant has been charged against revenue, in addition to which £50,800 has been applied to depreciation. The directors refer to the death of Mr. George Westinghouse, the founder and former chairman of the company. "He was a man of great organising capacity and extraordinary inventive powers, which had made his name famous all over the world." The board has appointed Mr. Ph. A. Lange to be managing director of the company.

South Metropolitan Electric Light and Power Co., Ltd.—The new issue of 25,000 6 per cent. cumulative second preference shares was largely over-subscribed.

Cleveland and Durham Electric Power.

The ordinary general meeting of the Cleveland and Durham Electric Power, Ltd., was held on March 30th at Newcastle-on-Tyne, Mr. R. W. Armstrong presiding in the absence of the chairman, Mr. James Falconer, M.P.

The Chairman, in moving the adoption of the report, read the speech Mr. Falconer had prepared. He explained that in accordance with a special resolution passed in December, and confirmed in January, the end of the financial year had been changed from June 30th to December 31st. The directors therefore submitted a report and statement of accounts for the six months ended December 31st. During that period the capital expenditure on works had amounted to £14,589, which had been expended on the construction of sub-stations in connection with the new business they had secured. The gross profit for the whole year ended December 31st amounted to £25,714. After providing for debenture and other interest there remained a net profit of £16,175, which, together with the sum of £2,466 brought forward from the last account, gave an available balance of £18,641, which the directors recommended should be appropriated as follows :—Dividend at the rate of 5 per cent. per annum for the six months on the preference shares, £8,342 ; to depreciation and renewals, £1,000 ; in reduction of expenses of the issue of debentures, £500 ; and carry forward £8,798.

The Hon. Robert James seconded the report.

Mr. A. Gemmell said that if the directors paid the preference dividend they proposed, either with or without the shareholders' sanction, they would be running the risk of having to refund the amount out of their own pockets when a Parliamentary inquiry took place. He alleged that every year since 1908 the control they had exercised over Parliamentary undertakings had been condemned by the Board of Trade.

The Chairman asked Mr. Gemmell to confine his remarks to the report with which they were dealing.

Mr. Gemmell said the recent dividends they had paid, and were seeking to pay, had been entirely derived from the Cleveland Parliamentary Co. The ordinary shareholders, after 7½ years, were not in sight of a dividend with £58,000 preference dividend in arrears. Mr. Gemmell urged that the time had come when a Parliamentary inquiry was imperative, not only in the interests of investors, but in the wider interests of a large industrial community to whom the cheapest possible supply of power was vital if the home manufacturer was to hold his own against foreign enterprise and successfully compete in the markets of the world.

The report was adopted, and the Chairman, in reply to a question, said it would be quite possible in future for separate accounts to be presented of the Parliamentary Co., the Cleveland Co., and the Northern Counties Co.

Windsor Electrical Installation Co., Ltd.—The capital expenditure during 1913 was £435, making the total £93,233. The profit for the year (including £451 brought forward) was £7,012. From this are deducted débenture and other interest, £791 ; dividend on 5 per cent. preference shares, £1,108 ; depreciation, renewal and reserve fund, £2,000 ; directors' fees, £350, leaving £2,763 available for dividend on the ordinary shares. The directors recommend that a dividend of 5 per cent., less income-tax, be paid on the ordinary shares, £408 being carried forward. During the year new lamps were connected equivalent to 1,650 of 8 C.P. : the total connected to December, 1913, being 52,726 lamps.

Dublin and Lucan Electric Railway Co.—Presiding at the annual meeting, Mr. J. W. Hill, J.P., said the gross receipts for the past year were £7,408, being £97 less than in the previous year. In August they were £205 up, but the tramway strike in Dublin which then took place prevented many city folk from using their cars. For the same reason autumn excursions had to be abandoned, and altogether the strike affected their income to the extent of between £400 and £500. Their expenses had increased by £578. The report was adopted.

Stock Exchange Notices.—The Committee has appointed special settling days as under :—

Wednesday, April 8th.—Constantinople Telephone Co.—Scrip fy. and py. (£25 per cent.) paid for £200,000 6 per cent. obligation bonds.

And ordered the following to be quoted in the Official List :—

Metropolitan Railway Co.—£975,000 consolidated ordinary (deferred divisible) stock, and £75,000 3½ per cent. "A" preference stock (ranking for dividend from July 1st, 1916).

Western Canada Power Co., Ltd.—Further issue of £90,000 5 per cent. 40-year ft. mortgage bonds of £100, Nos. B2,055 to 2,954.

Companies Struck off the Register.—The following companies have been struck off the Register, and are accordingly dissolved :—

Anglo-Russian Refuse Destructor Co.
Electricity Generating Co.
Ferabin Lamp and Electrical Accessories.

Isle of Wight Electric Light and Power Co., Ltd.—The directors' report for 1913 states that the year's trading, including £2,799 brought forward, shows a profit of £17,202. The directors propose that a dividend at the rate of 2½ per cent. per annum be paid on the ordinary shares, that £3,500 be placed to the renewal fund account, and £1,000 to the reserve account, carrying forward £3,428.—*Financial Times.*

Newcastle-on-Tyne Electric Supply Co.

A MEETING of this company was held on Tuesday to consider proposals for increasing the capital by £330,000, divided into 165,000 preference shares and 165,000 ordinary shares of £1 each, in connection with the acquisition of the business of the County of Durham Electrical Power Distribution Co.

Dr. J. T. Merz presided over a large attendance.

The CHAIRMAN moved the confirmation of the following resolution :—

That each of the existing £5 preference shares in the capital of the company, whether issued or unissued, be subdivided into five preference shares of £1 each, and that each of the existing £5 ordinary shares in the capital of the company, whether issued or unissued, be sub-divided into five ordinary shares of £1 each.

MR. J. H. ARMSTRONG seconded, and the motion was agreed to.

The CHAIRMAN next proposed the following resolution :—

That this extraordinary general meeting of the N.E.S. Co., Ltd., sanctions the creation by the directors of £330,000 additional capital, divided into 165,000 preference shares of £1 each, and 165,000 ordinary shares of £1 each. That the said additional preference shares shall rank *pari passu* in all respects with the existing preference shares, and shall accordingly be entitled *pari passu* with such shares to a preferential dividend of 5 per cent., and also to any surplus profits available for dividend, after 8 per cent. has been paid on the ordinary shares, until all the preference shares shall have received 8 per cent., when such shares shall rank *pari passu* with the ordinary shares for any further dividends which may be declared exceeding 8 per cent. The preference shares will be preferential as to dividends only. That the directors may, instead of offering such shares to the members, as provided by the articles of association of the company, dispose of the same at such time, in such manner and upon such terms and conditions as in their discretion they may consider to be in the best interests of the company.

This motion also was seconded by MR. ARMSTRONG, and carried without comment.

The CHAIRMAN, at the close of the business, said they had given the finishing stroke to an arrangement which he believed would be of benefit to the shareholders concerned.

Gateshead and District Tramways Co.—The annual meeting of this company was held on Monday. The report, which was then adopted, showed that for the year ended December, 1913, the total revenue amounted to £62,199. After deducting all expenses chargeable to revenue, including provision for renewals, £2,860, and writing off depreciation of investments, £1,537, there remains a balance on the year's working of £26,158, plus £1,828 brought forward. The directors propose to apply to reserve £4,500; to sinking fund for redemption of mortgages, £2,222; to dividend on the 6 per cent. preference shares, £756; to dividend for the year on the 5 per cent. preference shares, £6,000; to dividend on the ordinary shares at the rate of 6 per cent. per annum, £8,100; to bonus of 4s. each on the ordinary shares, £2,700; leaving to be carried forward £3,708. Expenditure chargeable to the tramway capital account during the year amounted to £2,203, making the entire capital outlay £336,646. The Northern General Transport Co., Ltd., made an offer to the shareholders respectively of the Jarrow and Tynemouth companies and this company to exchange their holdings for fully-paid holdings in the Transport Co. Holders of 94 per cent. of the total issued share capital of this company accepted the Transport Co.'s offer, and the Transport Co. has purchased the motor-omnibus undertaking of the company. The profit on the sale has been transferred to reserve. Consequent upon fine weather and good trade in the district, the traffic receipts show a satisfactory increase of £5,867.

South Wales Electrical Power Distribution Co.—The report for 1913 states (according to the *Financial Times*) that as under the working arrangement with the Treforest Electrical Consumers' Co., Ltd., the whole of the working expenses in connection with the undertaking are now borne by that company, there is for the time being no revenue account to be submitted. The business of the company has materially increased during the year, the units sold amounting to 25,812,031, as compared with 19,689,656 sold in 1912, an increase of 6,122,375 units. Owing, however, to the higher working cost, due principally to the increase in the cost of coal, the surplus is not so large as had been anticipated. The surplus, after payment of all working expenses and interest on prior lien debenture stock, and making due provision for depreciation of new plant, amounts to £2,915, which, together with the surplus accumulated in previous years, makes £10,379 towards discharging the indebtedness to certain consumers of the Treforest Co., amounting to £13,500. Application is being made to the Board of Trade for prov. lighting orders for the district of Abercarn and for the Borough of Cowbridge and parts of the rural districts of Cowbridge, Llantrisant, Llantwit Fardre and Penybont.

North of Scotland Electric Light and Power Co., Ltd.—The directors' report for the year ended December 31st, 1913, states that the company has made substantial progress during the year. The lamp connections in Montrose have increased from 24,765 to 30,192, equivalent 8-C.P. lamps; in Brechin, from 19,307 to 21,506, and in Inverness from 32,810 to 35,872, making a total of 87,570, connected in the three towns. The gross profit, including £2,221 brought forward from last year, is £9,295, and after meeting interest on debentures and loans, amounting to £2,880, and writing off £57 from suspense account, there remains a net profit of £6,359. The directors recommend a dividend at the rate of 3 per cent. for the year, which will absorb £1,500, that £2,000 be placed to renewal reserve account, that £1,000 be placed to a general reserve account, and that the balance, £1,859, be carried forward.

Tynemouth and District Electric Traction Co., Ltd.—The report for 1913 gives the total revenue at £15,028. The traffic receipts amounted to £13,973, an increase of £1,277. After providing for all expenses chargeable to revenue, including a provision of £1,600 for renewals, there is a surplus on the year's working of £5,215, making, with £298 brought forward, a total of £5,513. It is proposed to put to reserve £1,250; to dividend on the cumulative preference shares (5 per cent.), £1,525; to dividend on the ordinary shares (5 per cent.), £2,320; to be carried forward, £418. The expenditure chargeable to capital account during the year was £26. The Northern General Transport Co. made an offer to the shareholders respectively of the Gateshead and District Tramways Co., the Jarrow and District Electric Traction Co., Ltd., and this company, to exchange their holdings for fully-paid holdings in the Transport Co. Holders of 71 per cent. of the total issued share capital of this company have accepted the Transport Co.'s offer.

Prospectus.—*Electro Bleach and By-Products, Ltd.*—The list is to close to-day in an offer of £60,000 6 per cent. first mortgage debentures at 97½ per cent., and 100,000 7 per cent. participating preference shares of £1 each at par. The company has been formed to acquire the properties and assets of the Electrolytic Alkali Co., Ltd., in liquidation, and to carry on the manufacture of bleaching powder, soda compounds, salt, and numerous by-products. The works are divided substantially into two departments—namely, the electro-chemical plant and the power plant. Experts have prepared reports showing that the power plant is obsolete, and it is to be replaced by a modern installation enabling a saving in working cost of approximately £30,000 per annum to be effected. The old plant consists of 18 boilers, 1,500-H.P. gas plant, 10 steam engines and six gas engines. The new power plant will consist of three Parsons steam turbines and four Babcock boilers. The purchase price is £85,000, as to £75,000 in cash, £5,000 in ordinary shares, and £10,000 in cash or fully paid preference shares.

Milford-on-Sea Electric Supply Co., Ltd.—The directors report that, after charging all working expenses, writing £10 off preliminary expenses, and placing £155 aside for depreciation of plant, there remains a net profit of £314. A dividend of 5 per cent. is to be paid on the ordinary shares. At the annual meeting, the chairman (Dr. V. D. Harris) stated that that was the same dividend as had been declared by the company for the past five years. In explanation of the profits not having been quite so much, he attributed it partly to the introduction of the metallic-filament lamp, and to customers being more economical; also, two large houses had been empty for nine months, which made a difference of nearly £40. A special vote of thanks was accorded to Mr. Nicholson, the company's local representative.

Bromley (Kent) Electric Light and Power Co., Ltd.—The directors' report to December 31st, 1913, states that the lamp connections have increased from 107,649 to 115,518. The sale of current has increased from £16,651 to £17,097. The works have been maintained in good order and repair. The result of the year's trading, including £1,544 brought forward, shows a profit of £14,100, and after payment of debenture interest and trustees' fees, &c., amounting to £3,045, there is a balance of £11,055. An interim dividend at the rate of 4 per cent. per annum was paid for the half-year in October, and the directors recommend the payment of a further dividend for the second half-year at the rate of 10 per cent. per annum, making a total of 7 per cent. for the year, £4,000 being placed to general reserve account, and £1,805 carried forward.

Lancashire Dynamo and Motor Co., Ltd.—The report, as published in the *Financier*, states that, after providing for interest, and charging full depreciation, the profit for the year amounts to £16,192, plus £1,631 brought forward, making £17,823. It is proposed to pay a final dividend on the ordinary shares of 5 per cent., making 8 per cent. for the year, pay £700 in directors' fees, place to reserve £5,000, and carry forward £1,811. The output for the year quite reached expectations, but the cost of materials and the rates of wages both tended to reduce the margin of profit. The Canadian business has been somewhat troublesome, and has resulted in a loss on the year's working, but steps are being taken which, it is hoped, will result in an improvement in the current year.

Lymington (Hants.) Electric Light and Power Co., Ltd.—The directors report that the company continues to make satisfactory progress, the total proceeds from the sale of current having been increased from £2,636 to £2,781. The result of the year's trading, including £482 brought forward, shows a profit of £2,540, less interest on debentures, amounting to £450. £1,000 is to be placed to reserve, and a dividend at the rate of 5 per cent. per annum is to be paid on the preference shares, leaving £769 to be carried forward. During the year the company has purchased £400 first mortgage debentures.

Beauly Electric Supply Co., Ltd.—Mr. Daniel Grath presided at the annual meeting recently. When the supply was started they expected to have 500 lamps connected in the first year, but they had 700, in addition to a couple of motors and a number of irons. Steps were being taken to put down a 30-H.P. petrol stand-by set. The year's working showing a profit of £87, After putting £50 to reserve and paying 5 per cent. on the capital they carried forward £2, after paying 5 per cent. on the sum owing to the contractors.

STOCKS AND SHARES.

Tuesday Evening.

It is hardly necessary to say that finance is superseded for the time being by politics. Interest in the latter is so much greater than in the former that the public are minded to do neither investment nor speculation just now. The result is that prices are at the mercy of comparatively few cliques of operators, who run quotations up and down according to the political mood of the moment, the remarkable cheapness of money being the only underlying factor which has any influence other than the all-pervading one just mentioned.

How plentiful money is may be gauged by the fact that the Lombard Street market did not have to borrow from the Bank of England yesterday (Monday), notwithstanding the close of the quarter. This is said, by some of those who closely follow the course of the money market, to be unique in their recollection. New issues are being treated in the fashionable way; that is, the public refrain from applying for the stock on prospectuses, and, instead, leave orders with their brokers to pick it up as soon as allotments are out and the underwriters start the market at a discount below the issue price. The strength of Consols reflects the ease of the money market.

Several important electric lighting issues are on the way. Reference has already been made here to the probable offer of a substantial amount in Ordinary and Preference shares by the General Electric Company, and this may be out before we are. The South Metropolitan Electric Supply Company found all its 7 per cent. Preference shares readily subscribed by the public, and the price is about the par value of 20s. The South London Electric Supply intends to offer its new Preference shares, by way of rights, to the existing holders, who should get their allotments within the next 48 hours. The new Ordinary and Preference shares offered by the County of London Company are quoted at ¼ premium. The over-subscription of this issue is a pleasant compliment to the County of London board; a practical vote of confidence that the directors are the more likely to appreciate after the criticism launched at their scheme of a holding company.

The principal movement in the lists of prices overleaf is a nominal drop of 17 points in Central London Deferred Non-Assented stock. As this returned only £3 4s. 6d. per cent. on the money, as compared with the £4 18s. 7d. which the Assented yields, it was obvious that a sharp fall would take place if any stock came to market. There is little more than £32,000 of the Non-Assented left, so that it is hardly everybody's investment, even at the present price, which still leaves the return below that afforded by the Assented stock. Metropolitans and Districts are both lower. The Home Railway market is slightly nervous as to what may be the outcome of the threatened strike in the South Yorkshire coalfields; but prices, after being weak, recovered part of their previous losses. Metropolitan Surplus Lands is 2 points higher at 64. Underground Electric Railways issues shows no further changes.

Brazil and Mexico keep in the limelight so far as foreign politics are concerned. The news from Brazil has latterly been better, the rate of exchange hardening to nearly 16d., after being down to 15¼d. Seeing that a thirty-second of a penny in exchange makes a very considerable difference, it may be well understood how prices hang upon such movements as are now taking place from day to day. Brazil Tractions jumped to 85, some 7½ points above their recent lowest, but the price reacted to 83. Para Electrics are flat, both Ordinary and Preference receding to 4½, and the Debenture stock dropping to 91½. On the other hand, Rio Tramway bonds have justified the attention drawn to them on their drop, and the 5 per cent. first Mortgage bonds at 98 are 3 points better, while the Seconds have recovered 4 to 92. Sao Paulo Tramway bonds are a point up.

Most of the Mexican issues, where they have moved at all, show advances. Mexican Light and Power Common shares hardened to 45½ and Mexico Trams Sixes to 80½, being improvements of 3 and 3½ respectively. Other foreign issues are mainly steady. Brisbane Ordinary rose to 7¾. Anglo-Argentine Tramways new Debenture improved to ¼ premium.

In the Electricity Supply section prices were unsettled towards the end of last week by the threats of a general strike in all parts of the electrical world, including the Tubes. Later, however, these apprehensions subsided to some extent, and prices hardened, on the understanding that the trouble was confined to the contracting part of the trade. Charing Cross are a good spot at 5, showing a rise of ¼. Cities fell to 17, but partially recovered; and Counties, both Ordinary and Preference, are slightly better, allowing for the dividend markings. Urban Preference have again advanced on the improvement in the Company's position, evidenced by the recent report. South Metropolitan old Preference hardened to 1½, the issue of new shares being a decided success.

The British Westinghouse Company has re-entered the dividend list as regards its preference shares, after an absence of eight years. The bitter sacrifices of shareholders in the past are at last bearing fruit, and the report just out affords solid ground for encouragement to the long-suffering proprietors. Probably many of those who accompanied the concern through the worst of its days have sold their shares; and, as it so often happens, the latter buyers will reap the benefit of the losses endured by original subscribers. The company declares a dividend of 5 per cent. on the Preference shares, and the price is 5/32 up at 1 1/32, the good news having, of course, been discounted in advance to a large extent. The Debenture stock has risen a further 3½ points, but the Prior Liens remain at 103½. Callender's Cable rose ¼, while Telegraph Constructions remain weak, and show another fall of 10s. Babcocks & Wilcox are a trifle easier. The South Wales Electrical Power Company adds £14,000 to its previous debit at profit and loss, as the result of 1913, making the total debit £162,000.

The Telegraph market had a shock on Monday, in the shape of a disappointing report from the American Marconi Company. For 11 months there is a realised surplus of only $178,000, which the market interpreted as meaning no dividend on American Marconis yet, and accordingly the shares fell from a sovereign to 17s. 6d. Canadians dropped to 9s., the parent shares of both classes gave way, and the whole group once more became gloomy. Direct United States Cable shares are a little easier, but otherwise there is no particular change worth mentioning.

The Rubber market is strong, the price of the product steadily advancing and reviving the gossip of a possible shortage before the year is out. Rubber shares have dawdled in sympathy with the line taken by the raw material, business not having been sufficient to galvanise the market into any semblance of activity.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 1st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	,,	22/-	..
a ,, Oxalic	per lb.	2¾d.	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	,,	42/-	..
a Ammonia, Muriate (large cryst.)	per ton	£30 10	..
a Bleaching powder	,,	£6 5	..
a Bisulphide of Carbon	,,	£18	..
a Borax	,,	£17 10	..
a Copper Sulphate	,,	£22 10	..
a Lead, Nitrate	,,	£30 10	..
a ,, White Sugar	,,	£28	..
a ,, Peroxide	,,	£23	..
e Methylated Spirit	per gal.	9/6	..
a Potassium, Bichromate, in casks	per lb.	8¾d.	..
a Potash, Caustic (88/90 %)	per ton	£22 10	..
a ,, Chlorate	per lb.	3¾d.	..
a ,, Perchlorate	,,	3¾d.	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	,,	7½d.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	,,	£8 10	..
a ,, Recovered	,,	£5 10	..
a ,, Lump	,,	£5	..
a Soda, Caustic (white 70/72 %)	,,	£10	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£2 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£86	..
b ,, Wire, in ton lots (1 to 14 S.W.G.)	,,	£112	..
b ,, Sheet, in ton lots	,,	£113	..
p Babbitt's metal ingots	,,	£50 to £291	..
c Brass (rolled metal 2" to 12" basis)	per lb.	7½d.	..
c ,, Tube (brazed)	,,	9¾d.	..
c ,, ,, (solid drawn)	,,	7½d.	..
c ,, Wire, basis	,,	7¾d.	..
c Copper Tubes (brazed)	,,	10d.	½d. inc.
c ,, ,, (solid drawn)	,,	10d.	½d. inc.
g ,, Bars (best selected)	per ton	£80	£1 inc.
g ,, Sheet	,,	£80	£1 inc.
g ,, Rod	,,	£80	£1 inc.
d ,, (Electrolytic) Bars	,,	£67 10	£1 10 inc.
d ,, ,, Sheets	,,	£85 10	£1 10 inc.
d ,, ,, Rods	,,	£73	£1 10 inc.
d ,, ,, H.C. Wire	per lb.	8½d.	¼d. inc.
f Ebonite Rod	,,	4/6	..
f ,, Sheet	,,	4/-	..
n German Silver Wire	,,	1/10	..
h Gutta-percha, fine	,,	7/-	..
h India-rubber, Para fine	,,	3/0	¼d. dec.
l Iron Pig (Cleveland warrants)	per ton	50/9	9d. dec.
,, Wire, galv. No. 8, P.O. qual.	,,	£14	..
g Lead, English Pig	,,	£20 10	2/6 inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per box,	£7	10/- dec.
c Mica (in original cases) small	per lb.	6d. to 8s.	..
c ,, ,, medium	,,	3/6 to 6/-	..
c ,, ,, large	,,	7/6 to 11/-	..
o Nickel, sheet, wire, &c.	,,	3/6 to 4/6 nom	..
p Phosphor Bronze, plain castings	,,	1/1 to 1/3½	..
p ,, ,, rolled bars & rods	,,	1/0½ to 1/2	..
p ,, ,, rolled strip & sheet	,,	1/2½ to 1/5½	..
o Platinum	per oz,	185/-	..
d Silicium Bronze Wire	per lb.	10½d.	..
r Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	,,	£173 to £174	£2 dec.
n ,, Wire, Nos. 1 to 16	per lb.	2/4	..
p White Anti-friction Metals	per ton	£44 to £194	..
k Zinc, Sh's (Vieille Montagne bnd.)	,,	£25 12 6	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

SHARE LIST OF ELECTRICAL COMPANIES.

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations March 31st.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Bath Trams, Pref. Ord.	1	Nil	..	7/8 — 15/16	..	Nil
Do. 5 % Pref.	1	5	5	1/2 — 3/4	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	68 — 73 xd	..	6 3 3
Brit. Elec. Trac., 6 % Pref.	100	..	..	15½ — 17½	..	..
Do. Do. Deferred	100	..	..	6½ — 8½	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	89 — 92	..	6 10 5
Do. 7 % Non-Cum. Pr'f.	100	3	..	56 — 59	..	5 1 8
Do. 5 % Perp. Deb.	100	5	5	93 — 95 xd	..	5 1 0
Do. 4½ % 2nd Deb.	100	4½	4½	79 — 82	—1	5 9 9
Central London Railway, Ord.	100	3	3	57 — 62	..	4 16 9
Do. Gtd. Assented	100	..	4	81 — 83	+1	4 16 5
Do. Pref.	100	4	4	68 — 73	..	5 9 7
Do. Gtd. Assented	100	..	4	82 — 84	..	4 15 3
Do. Def.	100	2	2	40 — 45	—17	4 9 0
Do. Gtd. Assented	100	..	4	79 — 81	..	4 18 7
Do. 4 % Deb.	100	4	4	97 — 99	..	4 0 10
City & S. London, 5 % Pref., 1891	100	5	5	95 — 97	..	5 3 1
Do. Do. 1896	100	5	5	93 — 96	..	5 4 2
Do. Do. 1901	100	5	5	89 — 92	..	5 8 8
Do. Do. 1903	100	5	5	89 — 92	..	5 8 8
Do. 4 % Deb.	100	4	4	88 — 90	..	4 9 0
Hastings Trams, 6 % Pref.	1	6	6†	3/4 — 7/8	..	8 0 0
Do. 4½ % Deb.	100	4½	4½	65 — 70 xd	..	6 8 7
Isle of Thanet Trams, 5 % Pref.	5	2½	3	2 — 2½	..	6 0 0
Do. 4 % Deb.	100	4	4	71 — 76	..	5 5 8
Lancashire United, 5 % Deb.	100	5	5	87 — 89	..	5 12 4
London and Suburban, Ord.	1	..	..	7/16 — 9/16	..	..
Do. Do. 5 % Cum. Pref.	1	..	5†	3/4 — 7/8	..	6 18 4
Do. Do. 4½ % 1st Deb.	100	4½	4½	79 — 84	..	5 7 2

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations March 31st.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
London Elec. Railways, 4 % Deb.	100	4	4	89 — 91	..	4 7 11
London United Trams, 4 % Deb.	100	4	4	60 — 64	..	6 5 0
Metropolitan Railway Consol.	100	1⅜	1⅜	42½ — 43½	— ⅛	3 16 2
Do. Surplus Lands	100	2½	2½	63 — 65	+2	4 4 7
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 18 7
Do. 3½ % Pref.	100	3½	3½	82 — 84	..	4 3 4
Do. 3½ % Con. Pref.	100	3½	3½	80 — 82	..	4 5 4
Metropolitan District Ord.	100	Nil	..	28¼ — 28⅝	— ⅛	Nil
Do. 6 % Deb.	100	6	6	138 —141	..	4 5 1
Do. 4 % Deb.	100	4	4	93 — 95	..	4 4 3
Do. 4 % Prior Lien	100	4	4	97 — 99	..	4 0 10
Do. 4½ % First Pref.	100	4½	4½	84 — 87	—1	5 3 6
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 12 1
Metro. Elec. Trams, 4½ % Deb.	100	4½	4½	89 — 92	..	4 17 9
Do. 5 % Deb.	100	5	5	85½ — 88½ xd	..	5 13 0
Potteries, Ord.	1	3½	..	3/8 — 1/2	..	..
Do. 5 % Pref.	1	5	5	3/4 — 7/8	..	7 12 8
Do. 4½ % Deb.	100	4½	4½	84 — 87	..	5 3 6
South Metro. Trams, 6 % Pref.	1	6	6†	7/8 — 1	..	8 0 0
Do. 4 % Deb.	100	4	4	66 — 70	..	5 14 4
Underground Elec. Railways	10	..	..	3 — 3½	..	Nil
Do. "A"	1/-	..	..	3/8 — 7/16	..	Nil
Do. 6 % First Cum. Inc. Deb.	100	6	6	112 —114	..	5 5 3
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 0
Do. 6 % Income	100	6	6	89½ — 90½	..	6 12 7
Yorkshire (West Riding). Ord.	5	Nil	..	7/16 — 9/16	..	Nil
Do. 6 % Pref.	5	3	4	4 — 4½	..	4 9 0
Do. 4½ % Deb.	100	4½	4½	83 — 86	..	5 4 8

ELECTRIC RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5⅛	5⅛	4 1/16 — 4 1/8	..	5 17 4
Do. 2nd Pref.	5	5⅛	5⅛	4 1/16 — 4 1/8	..	6 0 7
Do. 4 % Deb.	100	4	4	92½ — 94½	..	4 4 8
Do. 4½ % Deb.	100	4½	4½	97 —100	..	4 10 0
Do. 5 % Deb.	100	5	5	96½ — 98½	..	5 1 6
Auckland Trams, 5 % Deb.	100	5	5	103 —106	..	4 14 3
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅞ — 11⅛	..	5 4 4
Do. 4½ % Deb.	100	4½	4½	94½ — 96½	..	4 13 3
Do. 5 % 2nd Deb.	100	5	5	98 —100	..	5 0 0
Brazilian Traction, Light and Power	$100	6	6†	82 — 84	+1	7 2 2
Brisbane Trams Invt., Ord.	5	8	8	7⅛ — 8	— ⅛	5 0 0
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	98 —101	..	4 9 1
B. Columbia Elec. Rly., Def.	100	8	8†	116 —120	+1	6 13 4
Do. Pref. Ord.	100	6	6	104 —108	..	5 11 1
Do. 5 % Pref.	100	5	5	101 —104	+1	4 16 2
Do. 4½ % 1st Mort. Deb.	40	4½	4½	98 —101	..	4 9 1
Do. 4½ % Vancouver Deb.	100	4½	4½	94 — 98	..	4 12 0
Do. 4½ % Con. Deb.	100	4½	4½	94½ — 96½	+ ⅛	4 8 1
Calcutta Trams, Ord.	5	7½	5†	6⅜ — 6⅝	..	5 11 1
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	96 — 99	..	4 11 0
Cape Electric Trams	1	5	5	2⅜ — 2⅝	..	6 13 4
City Buenos Aires Trams (1904)	5	5	5	5⅛ — 5⅜	..	4 10 11
Do. 4 % Deb.	100	4	4	91 — 96	..	4 3 4
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	89 — 93	..	5 7 8
Havana Elec. Rly., 5 % Bonds	$1000	5	5	93½ — 97½	..	5 2 6
Kalgoorlie Elec. Trams	1	Nil	..	0 — 1/16	..	Nil
Do. 5 % A Deb.	100	5	5	85 — 90	..	5 11 1
Do. 6 % B Deb.	100	3	..	10 — 20	..	Nil

La Plata Elec. Trams, Ord.	1	..	..	1/32 — 1/16	..	..
Do. Pref.	1	4½d.	6	1/32 — 1	..	6 0
Lisbon Elec. Trams, Ord.	1	6	6†	1 3/32 — 1 1/8	..	4 7 3
Do. 6 % Pref.	1	6	6	1 3/32 — 1 1/16	..	5 1 0
Do. 5 % Deb.	100	5	5	91 — 96	..	5 4 2
Madras Elec. Tr., 6% Cum. Pref.	5	6	6	4 7/16 — 5½ xd	..	5 14 3
„ Elec. Tr. (1904), Deb.	100	5	5	101 —103	..	4 17 0
Manaos Trams & Lt., 1st Deb.	100	5	5	79 — 82	..	6 2 0
Manila Elec. R. and Ltg., Bonds	$1000	5	5	98½ —100½	..	4 19 6
Mexico Trams Com	$100	7	7	72⅛ — 75½ xd	— ⅛	..
Do. Gen. Con. 5 % Bonds	..	5	5	79 — 83	+1	6 0 6
Do. 6 % Bonds	100	6	6	78 — 83	+3	7 4 7
Para Elec. Rlys. & Lt., Ord.	5	10	10	4 — 4⅛	— 1/8	11 2 2
Do. 6 % Pref.	5	6	6	4 — 4⅛	— ⅛	6 13 4
Do. 5 % 1st Deb.	100	5	5	90 — 93	—1½	5 7 5
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 — 5¼	..	5 9 1
Do. 4½ % 1st Deb.	100	4½	4½	95 — 97	..	4 12 9
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	97 — 99	+3	5 1 0
Do. 5 % Mort. Bonds	100	5	5	91 — 93	+4	5 7 5
Sao Paulo Tram., Lt. and P. 5 % 1st Deb.	$500	5	5	98 —101	+1	4 19 0
Singapore Trams, 5 % Deb.	100	5	5	86 — 90 xd	..	5 11 1
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 97	..	5 3 0
Un. Elec. Trams Monte Video	5	7	7	4⅜ — 5⅛	..	6 16 7
Do. 6 % Pref.	5	6	6	4⅛ — 5¼	..	5 14 3
Do. 5 % 1st Deb.	100	5	5	94 — 97	—1	5 3 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	93½ — 95½	..	4 14 3

ELECTRICITY SUPPLY AND POWER COMPANIES.—HOME.

Bournemouth & Poole, Ord.	10	6	7	9⅜ — 10⅜ xd	..	6 10 4
Do. 4½ % Pref.	10	4½	4½	9 — 10	..	4 10 0
Do. Second 6 % Pref.	10	6	6	10½ — 10⅝	..	5 11 7
Do. 4½ % Deb. Stock	Stock	4½	4½	94 — 97	..	4 12 9
Brompton & Kensington, Ord.	5	10	10†	8⅝ — 9⅜ xd	..	5 6 8
Do. 7 % Cum. Pref.	5	7	7	8½ — 8¾ xd	..	8 19 0
Central Electric Supply, 4 % Guar. Deb.	100	4	4	91½ — 94½	..	4 4 8
Charing Cross, West End & City	5	5	6	4⅜ — 5½	+ ⅛	5 14 3
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4¾	..	4 12 4
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4⅜	..	5 2 10
Do. Do. 4 % Deb.	100	4	4	92 — 94	..	4 5 1
Chelsea, Ord.	5	5	5	4½ — 5 xd	— ⅛	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	97 —100	..	4 10 0
City of London, Ord.	10	9	10	16⅜ — 17⅜	— ½	5 12 8
Do. 6 % Cum. Pref.	10	6	6	12½ — 13⅜	..	4 7 3
Do. 5 % Deb.	Stock	5	5	116 —120	..	4 7 4
Do. 4½ % Second Deb.	100	4½	4½	100 —103	..	4 8 1
County of London, Ord.	10	6	7	11⅜ — 12½ xd	..	5 15 8
Do. 6 % Pref.	10	6	6	11⅜ — 12 xd	+ ⅛	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	102⅜ —105½	..	4 5 9
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 7 5
Edmundson's, Ord.	£3	..	..	3/8 — 5/8	..	Nil
Do. 6 % Cum. Pref.	5	6	6	3½ — 4½	..	7 1 2
Do. 6 % Non-Cum. Pref.	5	..	..	1½ — 2	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	..	5 8 6
Folkestone	5	6	6	4½ — 4⅝ xd	..	6 6 4
Do. 5 % Cum. Pref.	5	5	5	4½ — 4⅝ xd	..	5 5 3
Do. 4½ % First Deb.	100	4½	4½	93 — 95	..	4 14 9

Hove	5	8	9	8½ — 9	..	5 0 0
Kensington & Knightsbridge, Ord.	5	8	9	7⅝ — 8	..	5 12 6
Do 4 % Deb.	Stock	4	4	90 — 92	..	4 7 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	76 — 80	..	5 12 0
London Electric, Ord.	3	2½	3	1⅜ — 1⅝	— ⅛	5 2 7
Do. 6 % Pref.	5	6	6	4⅜ — 5⅛	— ⅛	5 17 3
Do. 4 % First Mort. Deb.	Stock	4	4	92 — 95	+1	4 4 1
Metropolitan	5	4½	4½	3⅝ — 3¾	— ⅛	5 16 3
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 5	..	4 10 0
Do. 4½ % First Mort. Deb.	Stock	4½	4½	97 —100	..	4 10 0
Do. 3½ % Mort. Deb.	Stock	3½	3½	83 — 86	..	4 1 4
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	100 —103	..	4 17 1
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	9⅞ — 10⅛	..	5 14 3
Oxford	5	7	7	5 3/16 — 6 1/16	..	5 11 0
St. James' and Pall Mall, Ord.	5	10	12	9⅞ — 9⅞	— ⅛	6 3 1
Do. 7 % Pref	5	7	7	6⅞ — 7⅛	+ ⅛	4 18 8
Do. 3½ % Deb.	100	3½	3½	83 — 86	+1	4 1 4
South London, Ord.	4	5½	5½	2⅜ — 3⅛ xd	..	6 10 4
Do. 5 % First Mort. Deb.	100	5	5	98 —101	..	4 19 0
South Metropolitan, 7 % Pref.	1	7	7	1 3/16 — 1 5/16	+ 1/32	5 6 8
Do. 4½ % First Deb. Stock	100	4½	4½	94½ — 97½ xd	..	4 12 4
Urban, Ord.	£3	Nil	..	3/8 — 5/8	..	..
Do. 5 % Cum Pref.	5	3‡	4	2⅜ — 3⅜	+ ⅛	5 18 6
Do. 4½ % First Mort. Deb.	100	4½	4½	85 — 88 xd	+1	5 12 3
Westminster, Ord.	5	10	10	8½ — 9	..	5 11 1
Do. 4½ % Cum Pref.	5	4½	4½	5 1/16 — 5 3/16	..	4 4 9

* Unless otherwise stated, all shares are fully paid. † Interim Dividend. ‡ 3s. Cash and 2% in Funded Certs.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICITY SUPPLY AND POWER—COLONIAL AND FOREIGN.

NAME.	Stock or Share.	Dividends for		Closing Quotations March 31st.	Rise + or Fall —	Present Yield p.c.
Adelaide, 6 % Pref.	£5	6	6	5 — 5½	..	£ s. d. 5 14 8
Calcutta, Ord.	£5	8½	5†	7⅝ — 8	..	5 6 8
Do. 5 % Pref.	£5	5	5	5⅛ — 5⅜	..	4 13 0
Calgary Power, 1st Mort. Bds.	100	5	5	90½ — 92½	+ ½	5 8 0
Canadian Gen. El. Com.	$100	7	8	111 —115 xd	..	6 16 9
Do. 7 % Pref.	$100	7	7	119 —124 xd	..	5 9 5
Cordoba Lt., Power and T., Ord.	£1	5	..	7/16 — 8/16	..	7 12 0
Do. 5 % Deb.	100	5	5	87 — 90 xd	..	5 11 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	87 — 89	—1	6 14 10
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	91 — 94	..	5 6 5
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	93 — 95	..	5 5 3
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	1/16 — 2/16	..	Nil
Do. 6 % Pref.	£1	6	6†	23/32 — 25/32	..	10 11 10
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102 —104	..	4 16 2
Madras, Ord.	£5	Nil	..	1⅛ — 1⅜	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	103¼—106¼	..	4 14 0
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	65 — 70	..	7 2 10
Mexican Lt. & Power, Common	$100	4	4†	44 — 47	+3	..
Do. 7 % Cum. Pref.	$100	7	7	78 — 82	..	8 10 8
Do. 5 % 1st Mort. Gold Bds.	..	5	5	78 — 83	+1½	6 0 6
Do. 5 % 2nd Mort. Bonds	100	5	5	65 — 69	..	7 4 11
Monterey Rly., Light & Power, 5 % 1st Mort. Deb.	* 100	1919. 5	1913. 5	54 — 59	..	..
Montreal, Lt., H. and Power	$100	9	10†	280 —285	..	4 5 0
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5a	5a	10 — 20	..	..
River Plate, Ord.	Stock	10	..	245 —255	+10	3 18 5
Do. 6 % Non-Cum. Pref.	Do.	6	6	103 —108	..	5 11 1
Do. 5 % Deb. Stock	Do.	5	5	101 —103	..	4 17 0
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	102 —104	..	4 6 7
Shawinigan Water, Capital	$100	5½	6†	138 —142	..	4 4 6
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 7
Do. 4½ % Per. Deb.	Stock	4½	4½	101 —103	+1	4 7 3
Toronto Power, 4½ % Deb.	Do.	4½	4½	95 — 97	+1	4 12 9
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	88 — 90	..	5 11 1
Victoria Falls Power, Pref.	£1	6	6	33/32 — 35/32	..	7 13 4
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	101 —108	+1	5 16 8

MANUFACTURING COMPANIES.

Aron, Ord.	£1	7	..	33/32 — 37/32	..	8 5 0
Do. 6 % Pref.	£1	6	6	1 — 1¼	..	6 17 2
Babcock & Wilcox	£1	16	14†	8½ — 8¾	—1/32	4 18 6
Do. Pref.	£1	6	6	1 5/16 — 1 7/16	..	4 8 6
British Aluminium, Ord.	£1	..	..	1 3/32 — 1 7/32	..	..
Do. 6 % Cum. Pref.	£1	6	6	1 — 1	..	6 0 0
Do. 5 % Prior Liens Debs.	100	5	5	98 — 99	..	5 1 0
Do. Deb. Stk.	100	5	5	88 — 93	..	5 7 6
B.I. & Helsby Cables	£5	10	13	9½ — 10 xd	+ ½	6 10 0
Do. Pref.	£5	6	6	5⅞ — 6⅜	..	4 14 1
Do. Deb.	100	4½	4½	101 —104	—1	4 6 9
British Thomson-Houston, Deb.	100	4½	4½	92 — 94	..	4 15 9
British Westinghouse, Pref.	£2	Nil	5	13/32 — 14/32	+1/32	6 5 0
Do. Deb.	100	4	4	74 — 76	+3/4	5 5 3
Do. 6 % Prior Lien	100	6	6	102 —105	..	5 14 6
Browett, Lindley, Ord.	£1	..	..	2/- —3/-	..	Nil
Do. Pref.	£1	..	..	8/- —8/6	..	Nil
Brush, 7 % Pref.	£2	Nil	..	0 — ¼	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	80 — 85	..	5 17 8
Lo 4½ % Deb.	100	4½	4½	39 — 43	..	10 9 6
Do. 4½ % Second Deb.	100	4½	4½	28 — 27	..	16 13 4
Callender's Cable	£5	15	5†	11¾ — 12½	+ ½	6 0 0
Do. Pref.	£5	5	5	4 13/32 — 5 5/32	..	4 16 5
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Castner-Kellner	£1	20	22½	2¼ — 2⅜	..	..
Do. Deb.	100	4½	4½	104 —107	..	4 4 1
Crompton & Co., Deb.	100	5	5	83 — 85	..	5 17 8
Dick, Kerr	£1	Nil	..	3/32 — 5/32	..	..
Do. Pref.	£1	6	6	1/16 — 1 3/32 xd	..	7 7 8
Edison & Swan, A, £2 paid	£5	Nil	..	1/16 — 1/16	..	Nil
Do. fully paid	£5	Nil	..	1/16 — 1 1/32	..	Nil
Do. 4 % Deb.	100	4	4	58 — 62	..	6 9 1
Do. 5 % Second Deb.	100	5	5	62 — 67 xd	+1½	7 9 1
Electric Construction	£1	5	..	17/32 — 21/32	..	7 12 6
Do. Pref.	£1	7	7	1 3/32 — 1 5/32	..	6 11 7
Greenwood & Batley, Pref.	£10	7	7	6 3/32 — 7 1/32	..	9 18 2
Do. Deb.	100	5	5	92 — 94	..	5 6 5
General Electric, 6 % Pref.	£10	6	6	10 1/32 — 10 3/32	..	5 14 3
Do. Deb.	100	4	4	84 — 88 xd	..	4 11 0
Henley's, Ord.	£5	15	20	13 1/32 — 14 3/32	..	6 17 11
Do. Pref.	£5	4½	4½	4 13/32 — 5 1/32	+1/32	4 9 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
India-Rubber, G. & T.	£10	7½	7½	10 3/32 — 11 1/32	..	6 10 5
Do. Pref.	£10	5	5	8 3/32 — 9 1/32	..	5 5 3
Telegraph Construction	£12	20	20	36 1/32 — 38 1/32	— 1/32	6 5 1
Do. Deb.	100	4	4	98 —100	..	4 0 0
Willans & Robinson, 4 % 1st Mort. Deb.	100	4	4	65 — 69	..	5 16 0
Do. B 4 % Cum. Pref.	100	..	..	50 — 55	..	..

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	£10	4½	4½	5 3/32 — 6 1/32	..	7 4 0
Do. 5 % Deb. Red.	Stock	5	5	94 — 97	..	5 3 0
American Telep. & Teleg., Cap.	$100	8	8	122 —125 xd	..	6 8 0
Do. Collat. Trust	$1000	4	4	91 — 94	..	4 5 3
Anglo-American Telegraph	Stock	8	8	64 — 67	..	4 9 7
Do. 6 % Pref.	Do.	6	6	108¾—109¼	+ ½	5 9 4
Do. Def.	Do.	30/-	30/-	23¾— 24	..	6 5 0
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	£5	8	..	7⅜ — 7⅝	..	5 5 0
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	80¾— 82¾	—1	4 17 0
Cuba Telegraph	£10	6	6†	8¾— 9⅜	..	6 8 1
Do. 10 % Pref.	£10	10	10	15¾— 16⅜	..	6 19 5
Direct Spanish Telegraph, Ord.	£5	4	4	3¾— 4 xd	+ ⅛	5 0 0
Do. 10 % Cum. Pref.	£5	10	10	7¼— 8 xd	+ ¼	6 5 0
Direct United States Cable	£10	4	4†	6¾— 7⅛	— ⅛	5 12 4
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	97 — 99	..	4 10 10
Eastern Telegraph, Ord. Stock	Stock	7	7	132 —135	..	5 3 8
Do. 8½ % Pref. Stock	Do.	8½	8½	78 — 80	..	4 7 6
Do. 4 % Mort. Deb.	Do.	4	4	96 — 98	..	4 1 8
Eastern Extension	£10	7	7	12⅜ — 12⅝	..	5 8 9
Do. 4 % Deb.	Stock	4	4	94½ — 96½	..	4 3 0
Globe Telegraph and Trust	£10	6	6†	11¼ — 11⅝ xd	..	5 2 1
Do. 6 % Pref.	£10	6	6	12⅜ — 12⅝ xd	..	4 18 4
Great Northern Télégraph	£10	20	5†	32 — 34	..	5 17 8
Indo-European Telegraph	£5	13	5†	58 — 60	..	5 8 4
Mackay Companies Common	$100	5	5	85 — 89	..	5 12 4
Do. 4 % Cum. Pref.	$100	4	4	70 — 73	..	5 9 7
Marconi's Wireless Telegraph	£1	20	20	8⅝ — 8¾	—1/32	5 17 8
Do. 7 % Cum. Partic. Pref.	£1	17	..	2 1/16 — 2 3/32	— ⅛	5 15 8
Monte Video Telephone, Ord.	£1	6	6	1 1/16 — 1 3/32	..	6 8 0
Do. 5 % Pref.	£1	5	5	1 1/16 — 1 1/16	..	5 14 8
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	99⅜—100⅝	..	4 9 0
Oriental Telep. and Elec.	£1	10	8†	2¼ — 2⅜	..	4 4 3
Do. 6 % Cum. Pref.	£1	6	6	1 3/32 — 1 5/32	..	4 11 5
Do. 4 % Red. Deb.	Stock	4	4	87½ — 89½	..	4 9 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 —100	..	4 0 0
Reuter's	£10	10	10†	8 — 9	..	11 2 2
Submarine Cables Trust	Cert.	6	6	126 —129	..	4 13 0
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	96⅜— 98⅜	..	4 11 5
United River Plate Telephone	£5	8	6†	6⅜— 6⅞	..	5 16 5
Do. 5 % Cum. Pref.	£5	5	5	5⅛ — 5⅜	..	4 9 0
West Coast of America	£1	2½	..	1 1/16 — 1 1/16	..	4 8 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	96 — 99	..	4 0 10
West India and Panama Teleg.	£10	1½	1½	2⅜ — 2⅝	..	4 15 8
Do. 6 % Cum. 1st Pref.	£10	6	6	9⅜ — 10⅜	..	5 18 5
Do. 6 % Cum. 2nd Pref.	£10	6	6	9 — 9⅝	..	6 6 4
Do. 5 % Debs.	100	5	5	97 — 99	..	5 1 0
Western Telegraph, Ltd.	£10	7	7	13⅛ — 13⅜ xd	..	5 1 11
Do. 4 % Debs.	Stock	4	4	95½ — 97½	..	4 2 1
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	96 — 99	..	4 11 1

* Unless otherwise stated all shares are fully paid. † Interim dividend. *a* Paid in deferred interest warrants.

Bank rate of Discount 3 per cent., January 29th, 1914.

The London County Council and its Employés.—

At a recent meeting of the London County Council an agreement arrived at by the Electrical Conciliation Board with regard to the rates of pay of fitters, blacksmiths, fitters' labourers, and hammermen employed in the electrical section in the tramways department, was sanctioned. This agreement gives an increase of pay of ½d. per hour to all fitters and blacksmiths as from March 1st, and a further increase of ½d. in a year's time. This makes the rate of pay 9½d. per hour at present, and 10d. in 12 months, which is to be deemed the maximum for this class of work. Fitters' labourers at the Greenwich power station are to have an increase from 6½d. to 7d. per hour, and hammermen from 7d. to 7½d. This agreement is to remain in force for two years, during which no applications for further rises will be entertained. It was stated that a petition had been received from the coach body-makers, asking for a rise from 9½d. to 10d. per hour. There are 88 of these men in the employ of the Council's tramway department, and the cost of increasing the rate would be £510 per year. It was decided to refer the matter to the Conciliation Board for consideration. Although efforts are being made to reduce as much as possible the number of men employed seven days a week, it was reported that in the past four weeks 83, 105, 139 and 195 men — principally motormen and conductors—had been so kept on duty. This was largely due to illness, shortage of men, and to emergency work.

MOTOR AND CONTROL EQUIPMENTS FOR ELECTRIC LOCOMOTIVES.

(For abstract of paper read by Mr. F. Lydall *before the* Institution of Electrical Engineers, *see* Electrical Review, p. 421.)

Opening the discussion at Manchester on March 10th, Dr. E. Rosenberg said the list of geared and gearless motors printed in the paper showed the great difference between natural and forced ventilation. In motors of the order of 200 h.p., although the difference on the one-hour rating was slight, there was a great difference on continuous rating. In some cases the difference was given as 25 per cent. The author had stated that liquid resistances were seldom used; but on the Italian State Railways, where there were 140 locomotives of over 300,000 h.p., liquid resistances were employed. On certain rack and pinion railways in Switzerland the energy developed by the train going down hill, and running the motor as a generator, was consumed in resistances, which were artificially cooled by means of a large fan mounted in the cab.

Mr. Alderman Walker said that fighting to obtain orders for any particular system was not going to benefit either the country or the manufacturer in the end, and it was not a business proposition to suppose that any railway company would spend hundreds of thousands of pounds in electrifying, only to find that in a few years it was necessary to scrap its system and adopt a better one. It would be better that a central body should be organised to enter into conference with the railway people. This body should comprise representatives of manufacturers, institutions, the Local Government Board and the Board of Trade. It was to be hoped that the question of standardisation would be very seriously considered.

Mr. P. P. Wheelwright said it was regrettable that the British manufacturer was hardly mentioned in connection with railway electrification. He agreed with Alderman Walker regarding the necessity for a system adaptable to the great variety of conditions in this country.

Mr. W. Cramp said that in view of the enormous developments in the manufacture of worm gearing, it was difficult to realise why electric locomotives were designed with reciprocating connecting rods. There appeared also to be a lavish copying of the wheel diameter employed on steam locomotives. Why should the wheel diameter be limited? The author's remarks regarding the impaired radiating capacity of resistance grids when coated with aluminium paint were not supported by expert evidence.

Mr. Maybury asked whether steel bands had been used in place of the usual cog gearing or rods and levers. A paper read recently before the Manchester Association of Engineers stated that steel belts were far in advance of gearing in life and efficiency, and for the same power the width of steel required was only half that of leather.

Mr. Moffet said that an increase in the power of a motor at a given speed could be obtained by an increase in peripheral speed, this being obtained by an increase in gear ratio.

Dr. E. Rosenberg said it was essential that there should be an understanding between all parties concerned so that one system could be adopted, and if all railways would stick to that system the manufacturers could go ahead. Unfortunately at the present day no one could solve the problem of uniting all interests and selecting one system. Some railway engineers fought for single-phase, others low-tension direct current, whilst others swore by high-tension direct current. Regarding experiments, there was no better way of conducting them than by letting everyone have his own way. If an engineer believed in a thing he would put forward his best endeavour to prove that he was right; therefore if railway engineers were permitted to install what they considered best, the resultant experiments would show up the best systems. If railway electrification had been standardised six years ago, no one would have chosen high-tension direct current. The electrification of the British railways would not come to pass within 10 or 15 years, and if experiments were carried out on a small scale there would be no waste, even if the plant had to be scrapped. He fully believed that standardisation would come, but it should not stand in the way at present.

The Author, in reply, said the ratio between one-hour rating and continuous rating for railway motors without forced ventilation was about 2 to 1, whereas with forced ventilation the ratio was nearer equality, and certainly there was much difficulty in explaining some of the figures bearing on this point. Liquid resistances were used extensively on one or two railway systems. Whilst it was correct to say that speeds could be increased by using electric locomotives, it was to be recognised that electric locomotives were not made to run above the moderate speed of 60 to 65 miles per hour. Whilst the steam locomotive would only do 38 miles per hour on a certain gradient, the electric locomotive would do 55 miles per hour. Filtering the air used in forced ventilation was not general practice; the air in front of a railway train was comparatively good, and only the air following the train contained dust and dirt. The skidding point was a very desirable feature, as it limited the power of the driver to overload the motors seriously. Motors designed to give an acceleration of one-third gave all that was necessary. Designers used motors in which the peripheral speed was worked right up to the maximum, and it was a question whether worm gearing would enable this to be done. Single spur reduction gearing was usually sufficient to meet all the requirements of the case. Whilst it was an obvious disadvantage to have as many brushes as were indicated in some of the types of railway motors, the author did not consider that the renewals would be a serious matter, and with the large single-phase motors employed on railway work, the brush gear had, as a whole, been very satisfactory. He thought that with such irregular working as was demanded of electric locomotives, steel belts would not be likely to give good service on account of slipping.

In the course of the discussion at Birmingham, Mr. F. W. Carter said Mr. Lydall mentioned the number of steps in the control system as being dependent on the characteristics of the motor, and especially mentioned that the lower the internal resistance, the greater would be the number of steps. It was not, however, the resistance itself that came into the question, but rather the resistance drop, which might be no lower in the large motor than in the small motor, and, in fact, in some cases might be higher. Therefore, as between motors of the same type, there need not be any appreciable difference in the number of control steps. The slope of the speed-torque curve affected the number of steps required, but the effect was only appreciable when comparing motors of different types, such as single-phase and continuous-current motors. The real consideration which determined the number of control steps was indicated by Mr. Lydall, and was this:—That the locomotive must be capable of starting as heavy a load as possible on the heaviest grade, which determined the minimum tractive effort, whilst the maximum was limited by the adhesion of the driving wheels. In order to get as much as possible out of the locomotive, it was necessary to bring the maximum and minimum as near together as was practicable, and a large number of steps was therefore used in the control. Motor-cars frequently had only nine steps, for the above considerations did not apply to these, and the limiting feature was simply the amount of jerking that the passengers would stand when the train started. Mr. Lydall mentioned self-induction of the winding as not affecting the problem of starting. Large numbers of records of train current had been taken by automatic instruments, and had always shown the rise of current, when each step of resistance was cut out, to be practically instantaneous, and consequently the effect of self-induction was inappreciable in any case. Mr. Lydall referred to the bridge method of transition from series to parallel. The fact that the accelerating current of a locomotive was varied according to circumstances of load, grade and condition of rails, made this method of transition less valuable than in the case of motor-cars, where the same accelerating current could be maintained automatically under all conditions; for unless the transition was taken at the current for which the resistances were designed, a shock would be felt at the transition very similar in nature to that felt when less perfect systems were used. In other words, for locomotive work the bridge system was not as valuable as in motor-car work. Mr. Lydall mentioned that in the case where a high-voltage continuous-current supply was taken from an overhead line, it was not advisable to break the current violently by means of a strong magnetic blow-out, otherwise surges might be set up in the line. The speaker had never heard of this before, and believed that the 2,400-volt locomotives used on the Butte, Anaconda and Pacific Railway had circuit breakers fitted with magnetic blow-outs. Very little automatic control apparatus was used on a locomotive because the latter was sometimes required to give all the tractive effort of which it was capable, whilst at other times it was worked with a lower tractive effort. One could hardly adjust resistances to give even peaks under both conditions, and it was felt, in the case of such locomotives, that the control was best left in the hands of the driver

ELECTRIC BATTERY VEHICLES.

This subject was discussed by the Birmingham Local Section of the Institution of Electrical Engineers on March 18th.

Mr. R. A. Chattock said the importance to the electrical industry of the introduction of electric battery vehicles into this country could not be over-estimated. The Incorporated Municipal Electrical Association had formed a Committee called the "Electric Vehicle Committee," which would issue suggestions and advice on all matters electrical connected with such vehicles. The proposed charges for current were under consideration by this Committee, and it was hoped to standardise them in all parts of the United Kingdom. Prices from ½d. to 2d. per unit and over were suggested. His opinion was that 1d. per unit should be satisfactory to all parties, with a possible reduction at night time. From information of what had been done in America and on the Continent, it was obvious that a big demand for these vehicles could be created if they were properly brought before the notice of the public. They would be specially serviceable for carriers of heavy goods, such as railway companies, for large shopkeepers' delivery vans for public services, and for motor-omnibuses. A service of these had been running for some years at Brighton, and it was apparently giving great satisfaction. Delivery vans and lorries of from ½ to 5 tons' capacity seemed to be the most suitable vehicles for the adoption of electric driving. A 5-ton lorry should bring in somewhere about £80 per annum for current at 1d. per unit. It was evident, therefore, that a large revenue might be expected by the supply department if these vehicles came into general use. There was no doubt, however, that the public must be educated before they would recognise their usefulness, and it would cost money to do this. The makers must be prepared to demonstrate the use of these vehicles in all large towns, and to put forward figures giving

the cost of operation which could be proved to the prospective buyer. The existing garage proprietors, whose interests were at present bound up in the petrol-driven vehicles, obviously were not likely to provide facilities for charging the vehicles to commence with. The supply stations could help in the beginning by arranging charging facilities for such vehicles at the stations and sub-stations, though it was not considered that they should run garages permanently for this purpose. Assistance given in the early stages of the movement in this way would undoubtedly have a very stimulating effect on the use of the vehicles. The battery was the part of the vehicles about which there appeared to be the greatest doubt in the mind of the user, and, in order to get over this, the maker should be prepared to give reasonable maintenance guarantees over as long a period as possible. It was only by cutting the guarantee charges down to as low a figure as possible that the battery makers could assist in the pioneering work which would have to be done in this country before the public were convinced as to the great utility of the electric battery vehicle.

Mr. W. Fennell said that the Municipal Electrical Association represented only one section of one interest—that of the generation, sale and use of electricity by municipalities. If the Institution of Electrical Engineers had taken up this matter, it would have been possible to form a strong committee of its own members, which included eminent representatives of all the branches of the industry. The I.E.E. could render signal service to this branch of electrical engineering by organising a series of comprehensive papers on the details involved in producing and running electric battery vehicles. The standard price should be that charged to the user for the energy at the standard D.C. voltage which would be fixed for electric vehicle charging. Simplicity was the great thing to be aimed at in dealing with the non-technical public, who knew nothing about peak load times, and would be attracted by a certain reasonable price which they could check against their mileage, rather than a doubtful and varying cost which might be lower on the average. He would suggest 1½d. per unit into the battery to cover all costs of providing the supply at the standard D.C. voltage. The supply authorities could then bargain with the owners of the charging machinery to give the supply at such a price that they could profitably sell at the standard rate. The charging business would rapidly get out of the hands of the supply authorities, and, if his suggestion were adopted, it would allow a very large margin at the outset to those authorities who did the pioneer work, as they would secure both profits.

Mr. A. M. Taylor said that records were cited of a pleasure car seating two people and carrying some luggage, the weight of which was about 1 ton. This car was equipped with 50 cells giving a discharge capacity of approximately 225 ampere-hours at 60 volts. The cost of such a battery might be taken as £66. From numerous records available from the States, it would appear that 15,000 miles was a moderately safe estimate for the life of the battery. A battery which had been drawing a heavy truck for two years and had covered 17,000 miles, was still in actually better condition that when it started, and was probably good for another 17,000 miles. Taking, then, this figure for the battery and the capital outlay at £66, the expenses for renewals of the battery worked out to only 1d. per mile for a vehicle weighing only 1 ton. On a vehicle of which the gross weight was, say, 5 tons, it would be reasonable to assume that the cost of battery renewals would be 5d. per mile. It would seem from this that the cost for repairs was not at all exceptional. Careful records on the car showed that 542 miles were covered at an expenditure of 108 KW.-hours put into the battery. This worked out at 0·2 of a kilowatt-hour per mile, and per ton mile. From a rough calculation of the energy put into the motor, it would appear that the average traction coefficient was about 53 lb. per ton. At the above figure the cost of energy at 1d. per unit would work out to only one-fifth of 1d., and on a car with a gross weight of 5 tons it would be roughly 1d. per mile. This would be quite a reasonable figure. In Indianapolis a large number of 1-ton lorries (*i.e.*, carrying one ton) took on an average about two-thirds of a unit per mile, and ran some 11,000 to 15,000 miles under all sorts of conditions before the battery required renewing. One battery company had published the most elaborate tests of the performances of its cells under all sorts of conditions. A cell was charged for 15 hours in the wrong direction at the normal charging rate; after it had been re-charged the capacity was hardly altered in the least. A cell had been standing for two weeks fully discharged, without any solution in it and with the plates exposed to the air. After five normal charges and discharges the cell was practically as good as ever. A cell was allowed to stand for six months completely discharged; the performance at the end of the time, after re-charging, was practically the same as at the beginning. Another test was made consisting of heating a cell up to 130° F. and short-circuiting it to exhaustion, and charging afresh, repeating this up to some 500 times. Even after this terrible treatment the cells had as good a capacity as when they started, and after the first 150 or 200 such discharges, they had positively an increased capacity. After 1,000 such discharges the cells had only lost 20 per cent. of their original capacity. Allowing the equivalent of 50 miles per charge we should, on 500 charges, have the equivalent of 25,000 miles' run, and on 1,000 charges of 50,000 miles' run. The same cell was tested for damage due to vibration; after having been dropped through ½ in. nearly two million times, the performance was almost absolutely that at which the cell started. Three cells were taken after having been used for 17,000 miles on a 1-ton delivery van, and were found actually better in performance by 34 per cent. than when originally put in. These tests served to show that, in the case, at least, of the particular battery concerned, there should be no mistake as to the reliability of the results to be obtained, and circumstances had altered enormously since the days, not so long ago, when the failure of the batteries was the persistent cause of all trouble.

Mr. S. T. Allen said he had received from the Electric Vehicle Committee a list of questions asking him, amongst other things, what he proposed to charge in Wolverhampton for electricity supply for charging purposes in private garages (1) during peak times, (2) off peak times. He asked Mr. Chattock what exactly the Committee meant by peak time in this case. What might be considered as the peak time when supplying direct at the works would not necessarily be the peak time for the purposes of charging at private-house garages. The central station peak times might be, say, from 3 p.m. until 6 p.m., but the peak time in an ordinary residential street, where cooking and heating operations were carried on, was about 7.30 p.m. The addition of a load of, say, 250 amperes, due to the charging of half-a-dozen car batteries at such a time, would entail, probably, doubling the size of the mains and services in that street.

Mr. S. H. Bill said his firm ran a fleet of about 20 petrol vehicles, and as they generated electricity as a by-product at less than ½d. per unit, they were, so far as electric vehicles were concerned, in a much more favourable position than the majority of users, but their difficulty had always been in getting any reliable figures or data that would be guaranteed by the battery manufacturers. Their petrol costs ran out at from 3·88d. to 5·33d. per ton-mile with four-ton lorries, this including one driver and two draymen's wages, garage costs, renewals, insurances, licences, stores and 20 per cent. depreciation and 5 per cent. interest on capital. Even at these low figures they found it impossible to compete with horse-drawn vehicles on journeys of less than five miles. Alhough he believed the battery vehicle would eventually become common, he did not think the time would arrive in the immediate future.

Mr. A. C. Soutter said the lead cell now used for this class of work was an entirely different article to that used for the purpose several years ago, and as a proof of its reliability to-day, he referred to its successful use on the Brighton omnibuses during the past six or seven years.

Mr. R. J. Mitchell said that 1d. per unit should be the standard maximum charge, and wherever possible this should be reduced. Fuel economy afforded such an excellent talking point and such a valuable advertising feature, and, moreover, would be the means of such a large proportion of potential users taking advantage of the low fuel costs of the "electric"—the fuel aspect being the only one that the uninitiated could understand right away—that there seemed even more justification for extending the lowest possible rates to the electric vehicle user than held good with the domestic user of electrical energy. In 1903 Mr. Hibbert gave an interesting paper on the so-called E-type Edison accumulator. The E type was put into commission on quite an extensive scale in the States, and gave, on an average, 3½ years' service in vehicle operation before depreciating to 65 per cent. of its original rated capacity. The Adams Express Co. had in operation 200 trucks thus equipped, and got an average life of over three years from them. The present type of cell was brought out in 1909, and in 1912 the Adams Express Co. equipped 88 trucks with it. When subjected to a particular process of charging and discharging at very high rates, conducted at a very high electrolyte temperature—a combination of conditions well known to be very destructive—the E-type cell depreciated to 65 per cent. of its rated capacity after 200 cycles of this treatment, whereas the A-type, when put through the same process of abuse, indicated *4 per cent. above rated capacity*, after *eleven hundred* cycles; hence it was pretty plain that the A-type cell would very far outlive its guarantee period of four years, during which time it was warranted to give 100 per cent. of its rated output. On an average, the Edison cell might be relied upon to give 12 watt-hours per pound of complete assembled battery, at the discharge rates ordinarily met with in vehicle service. It would be of advantage if the technical colleges would get some of their research students to make reasonably complete accelerometer measurements of tractive resistance per ton over various road surfaces immediately in their own districts. It would then be possible for electric vehicle users and manufacturers to estimate beforehand in any projected service, the available mileage of any given type of electric vehicle per charge, and to figure out beforehand the working conditions with a great degree of accuracy. Another most useful work which our Universities could undertake would be research into the cost of operation of typical vehicles, including horse, petrol, steam, and later on, electrics, in our large cities. Such work had been undertaken very effectually by the Massachusetts Institute of Technology, and to the results gained very much of the enormous progress of the electric vehicle in America was due, since the analysis in question revealed the undoubted fact that in its own special sphere of utility, namely, that of carrying goods on hard town roads, the electric had been proved to be cheaper by 15 per cent. to 25 per cent. than any of its competitors.

Mr. E. Stubbs said that one of the greatest difficulties in the way of introducing electric vehicles was the first cost of the vehicle; something over £600 was given as the cost of a small delivery van. Few firms could be expected to face such an expenditure. The battery makers stood to gain quite as much as the supply authorities by the introduction of this system of transport; they should, therefore, be prepared to supply vehicles and maintain the batteries either for a fixed charge per annum or a fixed charge per mile. The actual cost of the supply for charging purposes was relatively unimportant, as it was a very small proportion of the total cost of running these vehicles.

THE MANUFACTURE OF TUNGSTEN FILAMENTS.

An interesting article appeared in *La Technique Moderne* recently, describing the manufacture of drawn-wire tungsten filaments, from which we derive the following particulars and illustrations.

Pure tungsten, although very fragile at a forging temperature can nevertheless be hammered, rolled and drawn at a white heat, and thus by degrees can be rendered malleable. The principal conditions which must be fulfilled in order to effect this transformation are as follows:—The metal must be free from oxide. The carbon content must not much exceed 0·05 per cent. (2·3 per cent. of W_3C). The metal must contain neither iron nor nickel, and must be almost free from sulphur, phosphorus, arsenic, antimony, selenium and tellurium. It must be heated almost to the melting point, before being worked in a cautious and very gradual manner; and finally, it is necessary to keep it out of contact with air as far as possible during the various stages of its manufacture.

The process comprises six operations:—

1. The production of a sufficiently pure metallic powder.
2. The agglomeration of this powder into bars.
3. The consolidation of the compressed bars.
4. The "burning" of the bars.
5. Working the bars by hammering or rolling.
6. Drawing the bars into wire.

1. To begin with, trioxide of tungsten is converted into metallic tungsten by heating it to a white heat in a current of pure hydrogen. This operation is carried out at a temperature of, say, 1,000° C., and results in a very fine powder of black tungsten, containing 1 to 2 per cent. of oxygen.

2. Agglomeration of the powder is effected with the aid of an hydraulic press, capable of exerting a pressure of about 5,000 kg. per cm^2. The bars thus obtained are exceedingly fragile, and their formation always requires very great skill. Fig. 1 show the press and mould employed. The latter is made to give bars 4 mm.

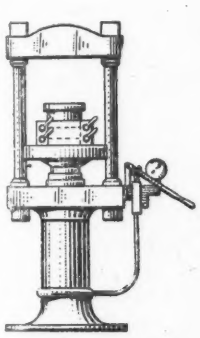


Fig. 1.—Hydraulic Press and Mould.

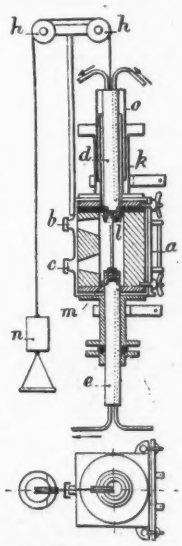


Fig. 2.—Electric Furnace.

thick and 130 mm. long. The powder which yields the best bars is that of medium fineness; if it is too fine or too coarse, the bars readily crumble after compression.

3. The bar is still so fragile that it breaks if laid on an uneven surface, or if it is picked up carelessly. It is given the desired firmness by heating it in a tubular furnace, in a current of hydrogen, for an hour, during which the temperature is gradually increased to red heat; an equal period is then allowed for raising the temperature to a degree a little higher than that which was used in producing the tungsten powder.

4. The "burning" process is intended to create an intimate union between the small tungsten crystals of which the bar is composed.

It must be carried on slowly and cautiously, for the quality of the filaments to be made later on depends upon this process. The final temperature to which the bars are heated is very near the melting point of tungsten, and must reach 2,850° C. In order to accomplish this, special apparatus must be used, and fig. 2 shows the kind of furnace most usually employed. The casing of the furnace, provided with small tubes *l* and *m* for the admission and discharge of hydrogen, is of cast-iron and is coated on the inside with graphite. The wall *a* of the furnace is removable, and is normally attached with screws and wing nuts. The opposite wall has two windows, *b* and *c*, to permit of supervising the operation. The copper electrodes *d* and *e* are provided with means for the circulation of water. The lower one *e* is fixed; the other, suspended from a cable passing over the pulleys *hh*, is balanced by a counterpoise *n*, and can slide in the insulated cover of the furnace. It carries a bell *o*, which plunges into a cylinder *k* filled with mercury. The bar to be treated is fixed to the electrodes by spring grips; when it is thus mounted in position, the furnace is closed and filled with hydrogen, and the heating current is turned on, oxygen being first carefully driven out of the apparatus. The contraction of the bar during burning is about 14 per cent. In order to heat bars of 16 to 20 mm.^{2} cross-section, a current of about 53 amperes per mm.^{2} is required for 2,650° C., and 57 amperes per mm.^{2} for 2,730° C.

5. The sintered bars are still brittle enough to break if dropped from a height of 30 to 40 cm., although one can hardly break them by hand. They can be properly worked only at a temperature of 1,200-1,300° C., but as they oxidise very rapidly at this temperature, it is necessary to carry out the hammering or rolling as far as possible in a current of hydrogen. The most suitable machine for this purpose is illustrated in figs. 3, 4 and 5.

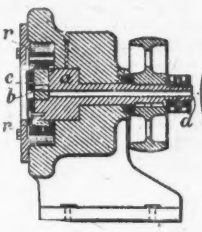


Fig. 3.—Section on A B.

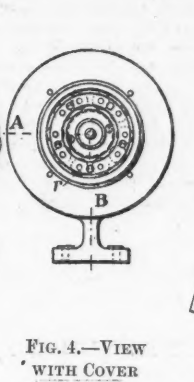


Fig. 4.—View with Cover Removed.

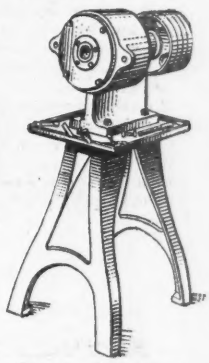


Fig. 5.—Complete Machine.

The dies *b* have, on their interior surface, a tapering groove of the same size as the bar; they are mounted with the hammers *c* in a recess in the hollow shaft *a*. The hammers, which have rounded external ends, are carried by the rotation of the shaft in front of the rollers *r*, which are arranged in a ring. Thanks to the rapid revolution of the shaft, the hammers are driven outwards by centrifugal force, but are forcibly thrown inwards on contact with each roller and transmit the blows to the dies. At 400 R.P.M. the hammers give about 4,000 blows per minute, which are distributed regularly over the surface of the bar. The latter, heated to 1,300° C. in a hydrogen atmosphere in a furnace, is quickly taken out and thrust into the machine, while the hydrogen necessary to prevent oxidation of the metal during the hammering is led in at *d*. The diameter of the bar can be reduced 4 per cent. at each pass into the machine, so that to obtain a wire of 1 mm. diameter from a bar 6 mm. square, some 50 passes are necessary. At every third pass the dies are replaced by others with a smaller groove, so that for the reduction of section above mentioned, 16 pairs of dies are needed. When at length a diameter of 0·75 mm. is reached, the tungsten has become ductile to a degree allowing of its being bent and worked at the ordinary temperature.

6. Drawing, however, is facilitated by heating the draw-plate, and fig. 6 shows an arrangement which gives good results. The draw-plate *a* consists of a cylindrical block in which the diamond is

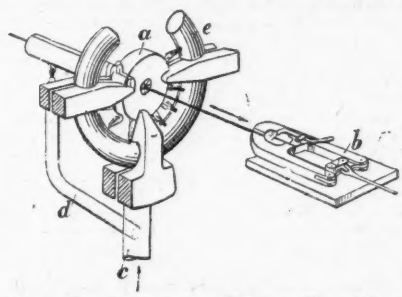


Fig. 6.—Arrangement of Heated Draw-Plate.

fixed in the usual way. Lighting gas is brought by the pipe *c* to a burner *e* arranged in an arc of a circle and pierced with little holes, to direct the flames upon the periphery of the plate. Before entering the die, the wire passes through a cylindrical bar which is also heated by a flame. Any type of draw tongs *b* can be used that is usually met with in steel wire drawing. The drawplate is lubricated with a mixture of Atcheson deflocculated graphite and water. As the wire must be pointed in order to be able to enter the die, chemical processes must be employed, because of the extreme hardness of the tungsten and of the very small diameter of some of the wires. The ends of the thick wires are plunged into melted potassium nitrate, and those of thin wires into a solution of potassium cyanide, so as to form the anodes of an electric circuit. By this means they are pointed very regularly, especially in the former case.

The dies employed in succession differ very little in bore. Starting with a wire of 0·65 mm. diameter, the dies decrease by

the cost of operation which could be proved to the prospective buyer. The existing garage proprietors, whose interests were at present bound up in the petrol-driven vehicles, obviously were not likely to provide facilities for charging the vehicles to commence with. The supply stations could help in the beginning by arranging charging facilities for such vehicles at the stations and sub-stations, though it was not considered that they should run garages permanently for this purpose. Assistance given in the early stages of the movement in this way would undoubtedly have a very stimulating effect on the use of the vehicles. The battery was the part of the vehicles about which there appeared to be the greatest doubt in the mind of the user, and, in order to get over this, the maker should be prepared to give reasonable maintenance guarantees over as long a period as possible. It was only by cutting the guarantee charges down to as low a figure as possible that the battery makers could assist in the pioneering work which would have to be done in this country before the public were convinced as to the great utility of the electric battery vehicle.

Mr. W. Fennell said that the Municipal Electrical Association represented only one section of one interest—that of the generation, sale and use of electricity by municipalities. If the Institution of Electrical Engineers had taken up this matter, it would have been possible to form a strong committee of its own members, which included eminent representatives of all the branches of the industry. The I.E.E. could render signal service to this branch of electrical engineering by organising a series of comprehensive papers on the details involved in producing and running electric battery vehicles. The standard price should be that charged to the user for the energy at the standard D.C. voltage which would be fixed for electric vehicle charging. Simplicity was the great thing to be aimed at in dealing with the non-technical public, who knew nothing about peak load times, and would be attracted by a certain reasonable price which they could check against their mileage, rather than a doubtful and varying cost which might be lower on the average. He would suggest 1½d. per unit into the battery to cover all costs of providing the supply at the standard D.C. voltage. The supply authorities could then bargain with the owners of the charging machinery to give the supply at such a price that they could profitably sell at the standard rate. The charging business would rapidly get out of the hands of the supply authorities, and, if his suggestion were adopted, it would allow a very large margin at the outset to those authorities who did the pioneer work, as they would secure both profits.

Mr. A. M. Taylor said that records were cited of a pleasure car seating two people and carrying some luggage, the weight of which was about 1 ton. This car was equipped with 50 cells giving a discharge capacity of approximately 225 ampere-hours at 60 volts. The cost of such a battery might be taken as £66. From numerous records available from the States, it would appear that 15,000 miles was a moderately safe estimate for the life of the battery. A battery which had been drawing a heavy truck for two years and had covered 17,000 miles, was still in actually better condition that when it started, and was probably good for another 17,000 miles. Taking, then, this figure for the battery and the capital outlay at £66, the expenses for renewals of the battery worked out to only 1d. per mile for a vehicle weighing only 1 ton. On a vehicle of which the gross weight was, say, 5 tons, it would be reasonable to assume that the cost of battery renewals would be 5d. per mile. It would seem from this that the cost for repairs was not at all exceptional. Careful records on the car showed that 542 miles were covered at an expenditure of 108 KW.-hours put into the battery. This worked out at 0·2 of a kilowatt-hour per mile, and per ton mile. From a rough calculation of the energy put into the motor, it would appear that the average traction coefficient was about 53 lb. per ton. At the above figure the cost of energy at 1d. per unit would work out to only one-fifth of 1d., and on a car with a gross weight of 5 tons it would be roughly 1d. per mile. This would be quite a reasonable figure. In Indianapolis a large number of 1-ton lorries (*i.e.*, carrying one ton) took on an average about two-thirds of a unit per mile, and ran some 11,000 to 15,000 miles under all sorts of conditions before the battery required renewing. One battery company had published the most elaborate tests of the performances of its cells under all sorts of conditions. A cell was charged for 15 hours in the wrong direction at the normal charging rate; after it had been re-charged the capacity was hardly altered in the least. A cell had been standing for two weeks fully discharged, without any solution in it and with the plates exposed to the air. After five normal charges and discharges the cell was practically as good as ever. A cell was allowed to stand for six months completely discharged; the performance at the end of the time, after re-charging, was practically the same as at the beginning. Another test was made consisting of heating a cell up to 130° F. and short-circuiting it to exhaustion, and charging afresh, repeating this up to some 500 times. Even after this terrible treatment the cells had as good a capacity as when they started, and after the first 150 or 200 such discharges, they had positively an increased capacity. After 1,000 such discharges the cells had only lost 20 per cent. of their original capacity. Allowing the equivalent of 50 miles per charge we should, on 500 charges, have the equivalent of 25,000 miles' run, and on 1,000 charges of 50,000 miles' run. The same cell was tested for damage due to vibration; after having been dropped through ½ in. nearly two million times, the performance was almost absolutely that at which the cell started. Three cells were taken after having been used for 17,000 miles on a 1-ton delivery van, and were found actually better in performance by 34 per cent. than when originally put in. These tests served to show that, in the case, at least, of the particular battery concerned, there should be no mistake as to the reliability of the results to be obtained, and circumstances had altered enormously since the days, not so long ago, when the failure of the batteries was the persistent cause of all trouble.

Mr. S. T. Allen said he had received from the Electric Vehicle Committee a list of questions asking him, amongst other things, what he proposed to charge in Wolverhampton for electricity supply for charging purposes in private garages (1) during peak times, (2) off peak times. He asked Mr. Chattock what exactly the Committee meant by peak time in this case. What might be considered as the peak time when supplying direct at the works would not necessarily be the peak time for the purposes of charging at private-house garages. The central station peak times might be, say, from 3 p.m. until 6 p.m., but the peak time in an ordinary residential street, where cooking and heating operations were carried on, was about 7.30 p.m. The addition of a load of, say, 250 amperes, due to the charging of half-a-dozen car batteries at such a time, would entail, probably, doubling the size of the mains and services in that street.

Mr. S. H. Bill said his firm ran a fleet of about 20 petrol vehicles, and as they generated electricity as a by-product at less than ¼d. per unit, they were, so far as electric vehicles were concerned, in a much more favourable position than the majority of users, but their difficulty had always been in getting any reliable figures or data that would be guaranteed by the battery manufacturers. Their petrol costs ran out at from 3·88d. to 5·33d. per ton-mile with four-ton lorries, this including one driver and two draymen's wages, garage costs, renewals, insurances, licences, stores and 20 per cent. depreciation and 5 per cent. interest on capital. Even at these low figures they found it impossible to compete with horse-drawn vehicles on journeys of less than five miles. Alhough he believed the battery vehicle would eventually become common, he did not think the time would arrive in the immediate future.

Mr. A. C. Soutter said the lead cell now used for this class of work was an entirely different article to that used for the purpose several years ago, and as a proof of its reliability to-day, he referred to its successful use on the Brighton omnibuses during the past six or seven years.

Mr. R. J. Mitchell said that 1d. per unit should be the standard maximum charge, and wherever possible this should be reduced. Fuel economy afforded such an excellent talking point and such a valuable advertising feature, and, moreover, would be the means of such a large proportion of potential users taking advantage of the low fuel costs of the "electric"—the fuel aspect being the only one that the uninitiated could understand right away—that there seemed even more justification for extending the lowest possible rates to the electric vehicle user than held good with the domestic user of electrical energy. In 1903 Mr. Hibbert gave an interesting paper on the so-called E-type Edison accumulator. The E type was put into commission on quite an extensive scale in the States, and gave, on an average, 3½ years' service in vehicle operation before depreciating to 65 per cent. of its original rated capacity. The Adams Express Co. had in operation 200 trucks thus equipped, and got an average life of over three years from them. The present type of cell was brought out in 1909, and in 1912 the Adams Express Co. equipped 88 trucks with it. When subjected to a particular process of charging and discharging at very high rates, conducted at a very high electrolyte temperature—a combination of conditions well known to be very destructive—the E-type cell depreciated to 65 per cent. of its rated capacity after 200 cycles of this treatment, whereas the A-type, when put through the same process of abuse, indicated *4 per cent. above rated capacity*, after *eleven hundred* cycles; hence it was pretty plain that the A-type cell would very far outlive its guarantee period of four years, during which time it was warranted to give 100 per cent. of its rated output. On an average, the Edison cell might be relied upon to give 12 watt-hours per pound of complete assembled battery, at the discharge rates ordinarily met with in vehicle service. It would be of advantage if the technical colleges would get some of their research students to make reasonably complete accelerometer measurements of tractive resistance per ton over various road surfaces immediately in their own districts. It would then be possible for electric vehicle users and manufacturers to estimate beforehand in any projected service, the available mileage of any given type of electric vehicle per charge, and to figure out beforehand the working conditions with a great degree of accuracy. Another most useful work which our Universities could undertake would be research into the cost of operation of typical vehicles, including horse, petrol, steam, and later on, electrics, in our large cities. Such work had been undertaken very effectually by the Massachusetts Institute of Technology, and to the results gained very much of the enormous progress of the electric vehicle in America was due, since the analysis in question revealed the undoubted fact that in its own special sphere of utility, namely, that of carrying goods on hard town roads, the electric had been proved to be cheaper by 15 per cent. to 25 per cent. than any of its competitors.

Mr. E. Stubbs said that one of the greatest difficulties in the way of introducing electric vehicles was the first cost of the vehicle; something over £600 was given as the cost of a small delivery van. Few firms could be expected to face such an expenditure. The battery makers stood to gain quite as much as the supply authorities by the introduction of this system of transport; they should, therefore, be prepared to supply vehicles and maintain the batteries either for a fixed charge per annum or a fixed charge per mile. The actual cost of the supply for charging purposes was relatively unimportant, as it was a very small proportion of the total cost of running these vehicles.

THE MANUFACTURE OF TUNGSTEN FILAMENTS.

An interesting article appeared in *La Technique Moderne* recently, describing the manufacture of drawn-wire tungsten filaments, from which we derive the following particulars and illustrations.

Pure tungsten, although very fragile at a forging temperature can nevertheless be hammered, rolled and drawn at a white heat, and thus by degrees can be rendered malleable. The principal conditions which must be fulfilled in order to effect this transformation are as follows:—The metal must be free from oxide. The carbon content must not much exceed 0·05 per cent. (2·3 per cent. of W_2C). The metal must contain neither iron nor nickel, and must be almost free from sulphur, phosphorus, arsenic, antimony, selenium and tellurium. It must be heated almost to the melting point, before being worked in a cautious and very gradual manner; and finally, it is necessary to keep it out of contact with air as far as possible during the various stages of its manufacture.

The process comprises six operations:—

1. The production of a sufficiently pure metallic powder.
2. The agglomeration of this powder into bars.
3. The consolidation of the compressed bars.
4. The "burning" of the bars.
5. Working the bars by hammering or rolling.
6. Drawing the bars into wire.

1. To begin with, trioxide of tungsten is converted into metallic tungsten by heating it to a white heat in a current of pure hydrogen. This operation is carried out at a temperature of, say, 1,000° C., and results in a very fine powder of black tungsten, containing 1 to 2 per cent. of oxygen.

2. Agglomeration of the powder is effected with the aid of an hydraulic press, capable of exerting a pressure of about 5,000 kg. per cm^2. The bars thus obtained are exceedingly fragile, and their formation always requires very great skill. Fig. 1 show the press and mould employed. The latter is made to give bars 4 mm.

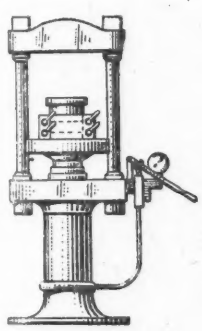


Fig. 1.—Hydraulic Press and Mould.

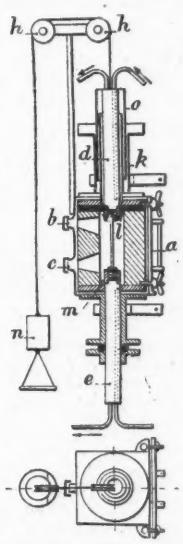


Fig. 2.—Electric Furnace.

thick and 130 mm. long. The powder which yields the best bars is that of medium fineness; if it is too fine or too coarse, the bars readily crumble after compression.

3. The bar is still so fragile that it breaks if laid on an uneven surface, or if it is picked up carelessly. It is given the desired firmness by heating it in a tubular furnace, in a current of hydrogen, for an hour, during which the temperature is gradually increased to red heat; an equal period is then allowed for raising the temperature to a degree a little higher than that which was used in producing the tungsten powder.

4. The "burning" process is intended to create an intimate union between the small tungsten crystals of which the bar is composed.

It must be carried on slowly and cautiously, for the quality of the filaments to be made later on depends upon this process. The final temperature to which the bars are heated is very near the melting point of tungsten, and must reach 2,850° C. In order to accomplish this, special apparatus must be used, and fig. 2 shows the kind of furnace most usually employed. The casing of the furnace, provided with small tubes *l* and *m* for the admission and discharge of hydrogen, is of cast-iron and is coated on the inside with graphite. The wall *a* of the furnace is removable, and is normally attached with screws and wing nuts. The opposite wall has two windows, *b* and *c*, to permit of supervising the operation. The copper electrodes *d* and *e* are provided with means for the circulation of water. The lower one *e* is fixed; the other, suspended from a cable passing over the pulleys *hh*, is balanced by a counterpoise *n*, and can slide in the insulated cover of the furnace. It carries a bell *o*, which plunges into a cylinder *k* filled with mercury. The bar to be treated is fixed to the electrodes by spring grips; when it is thus mounted in position, the furnace is closed and filled with hydrogen, and the heating current is turned on, oxygen being first carefully driven out of the apparatus. The contraction of the bar during burning is about 14 per cent. In order to heat bars of 16 to 20 mm.^{2} cross-section, a current of about 53 amperes per mm.^{2} is required for 2,650° C., and 57 amperes per mm.^{2} for 2,730° C.

5. The sintered bars are still brittle enough to break if dropped from a height of 30 to 40 cm., although one can hardly break them by hand. They can be properly worked only at a temperature of 1,200-1,300° C., but as they oxidise very rapidly at this temperature, it is necessary to carry out the hammering or rolling as far as possible in a current of hydrogen. The most suitable machine for this purpose is illustrated in figs. 3, 4 and 5.

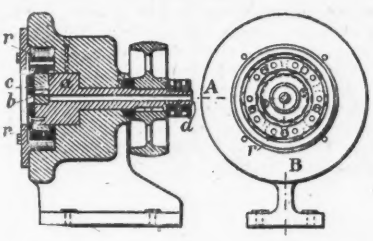


Fig. 3.—Section on A B.

Fig. 4.—View with Cover Removed.

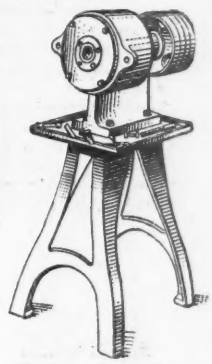


Fig. 5.—Complete Machine.

The dies *b* have, on their interior surface, a tapering groove of the same size as the bar; they are mounted with the hammers *c* in a recess in the hollow shaft *a*. The hammers, which have rounded external ends, are carried by the rotation of the shaft in front of the rollers *r*, which are arranged in a ring. Thanks to the rapid revolution of the shaft, the hammers are driven outwards by centrifugal force, but are forcibly thrown inwards on contact with each roller and transmit the blows to the dies. At 400 R.P.M. the hammers give about 4,000 blows per minute, which are distributed regularly over the surface of the bar. The latter, heated to 1,300° C. in a hydrogen atmosphere in a furnace, is quickly taken out and thrust into the machine, while the hydrogen necessary to prevent oxidation of the metal during the hammering is led in at *d*. The diameter of the bar can be reduced 4 per cent. at each pass into the machine, so that to obtain a wire of 1 mm. diameter from a bar 6 mm. square, some 50 passes are necessary. At every third pass the dies are replaced by others with a smaller groove, so that for the reduction of section above mentioned, 16 pairs of dies are needed. When at length a diameter of 0·75 mm. is reached, the tungsten has become ductile to a degree allowing of its being bent and worked at the ordinary temperature.

6. Drawing, however, is facilitated by heating the draw-plate, and fig. 6 shows an arrangement which gives good results. The draw-plate *a* consists of a cylindrical block in which the diamond is

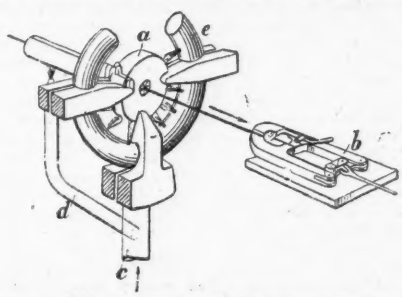


Fig. 6.—Arrangement of Heated Draw-Plate.

fixed in the usual way. Lighting gas is brought by the pipe *c* to a burner *e* arranged in an arc of a circle and pierced with little holes, to direct the flames upon the periphery of the plate. Before entering the die, the wire passes through a cylindrical bar which is also heated by a flame. Any type of draw tongs *b* can be used that is usually met with in steel wire drawing. The drawplate is lubricated with a mixture of Atcheson deflocculated graphite and water. As the wire must be pointed in order to be able to enter the die, chemical processes must be employed, because of the extreme hardness of the tungsten and of the very small diameter of some of the wires. The ends of the thick wires are plunged into melted potassium nitrate, and those of thin wires into a solution of potassium cyanide, so as to form the anodes of an electric circuit. By this means they are pointed very regularly, especially in the former case.

The dies employed in succession differ very little in bore. Starting with a wire of 0·65 mm. diameter, the dies decrease by

about 0·0125 mm. as far as 0·35 mm.; from this size down to 0·1 mm., the interval is 0·0065 mm.; from 0·1 to 0·075 mm. it is 0·003 mm.; from 0·075 to 0·0375 mm. it is 0·0025 mm., and finally from 0·0375 to 0·025 mm. and below it becomes 0·00125 mm. Thus 100 dies are necessary. During the drawing between 0·65 and 0·45 mm., the temperature should be from 600 to 650° C.; from 0·45 to 0·25 it is 500° C., and finally, for the smaller diameters it is about 400° C.

When a wire of the initial diameter of 0·65 mm. has been brought down to 0·18 mm., it can be wound round the finger at the ordinary temperature without breaking. Below 0·1 mm. the wire becomes as ductile as any other metal, and can be drawn at atmospheric temperature, though for the sake of facility it is preferred to heat the dies up to the end.

The wire thus obtained is coloured blue-black by the graphite and by a little oxide. In order to clean it, the wire is heated to dull red by passing it into a glass tube containing hydrogen, and keeping it in contact with two copper cylinders, to which is led an electric current. The finished wire is silver-white, and has an extraordinarily high tensile strength, varying from 420 to 460 kg. per mm^2. It is non-magnetic, and does not oxidise at the normal temperature. It is insoluble in hydrochloric, nitric and hydrofluoric acids; it dissolves slowly in a mixture of nitric and hydrochloric acids, and very rapidly in a mixture of concentrated hydrofluoric and nitric acids. Pure sulphuric acid attacks it only at a high temperature. The nitrate and chlorate of potash transform it quickly into trioxide of tungsten.

ELECTRIC WINDING AT COLLIERIES.

A meeting of the West of Scotland Branch of the Association of Mining Electrical Engineers was held on March 20th, at Glasgow, when discussion was resumed on the paper contributed by Mr. James Gillespie on "Electric Winding at Collieries."

Mr. S. A. Simon (Glasgow) said he felt that Mr. Gillespie had not done electric winding full justice. Mr. Gillespie gave the chief factor which governed the running costs of any winder as the cost per shaft h.p.-hour; he was glad to note that the author had appreciated the importance of this basis of comparison, which in former discussions had often been attacked, especially by opponents of electric winding. Unfortunately, however, he did not state the consumption per shaft h.p.-hour of the winders which he described. He did not think that even the staunchest advocate of steam winding denied that the actual steam consumption of electric winders deriving their current from up-to-date electric generating plant was considerably lower than that of steam winders. Their arguments in favour of the latter were invariably based on other considerations, such as lower capital cost, greater flexibility, and, latterly, the advantages of the combination of a steam winder with exhaust or mixed-pressure turbines, driving generators or other rotary machinery. He had met engineers who had argued that it did not matter how uneconomical a steam engine might be if they had a turbine which could utilise the exhaust steam from it, because the more live steam the engine consumed the more exhaust steam was available for the turbine. He need not take up time exposing this palpable fallacy. It should be borne in mind, however, that even in a mixed-pressure turbo-generating plant it was not always possible so to arrange the electrical load as to make it coincide in quantity and time with the available exhaust steam, so that at times steam was blown off the accumulators, and at other times live steam from the boiler had to supplement the exhaust supply. In up-to-date accumulator plants the excess of steam was often used for feed heating, but there were constant losses by radiation as well as drop of pressure between the back pressure of the engine, from which steam was supplied to the accumulator, and the supply pressure to the turbine. This was more particularly the case where a loaded check valve was fitted between the accumulator and the winding engine, to prevent the alterations in pressure in the accumulator going back to the winding engine and affecting its working conditions by altering the back pressure. This drop of pressure generally amounted to 3, and sometimes even to 5 or 6 lb., which, in a total of 12 to 18 lb. absolute pressure, represented a very considerable loss of available energy. He had recently occasion to draw up a comparison for a concrete case between all-electric plant and steam winders with mixed-pressure turbines. The former was based on costly Ilgner winding plant, and with steam winding the capital expenditure was between 25 per cent. and 30 per cent. more than for the all-electric plant, including boilers, pipe work, feed pumps, turbo-generators, condensers, cooling towers and winders—in fact, complete plants, but excluding buildings and foundations, which would be assumed the same for both equipments. With coal costing 3s. 6d. per ton, a saving for the electric winder was shown amounting to 20 per cent. on the additional capital outlay. He would like to add that in the comparative figures a much lower steam consumption was assumed for the steam winder than the average stated in Mr. Gillespie's paper; basing the calculation on the latter figure, a saving of 27½ per cent. would be shown. The conditions were naturally different when there was an existing steam winder which was efficiently and satisfactorily performing its duties; in many such cases the retention of the engine and the utilisation of its exhaust steam in a turbine plant was sound engineering, and could be justified on technical as well as economic grounds. Each case must be considered on its own merits, and a thorough study of all the factors made before a decision was arrived at as to the type of plant best to adopt. The higher the price of fuel the better it paid to increase the capital outlay in order to obtain more efficient plant, and there appeared no doubt that with the increasing burdens placed on colliery owners due to modern legislation and the ever-increasing demands of the working man for higher pay and better social conditions, the cost of coal was more likely to rise than to fall. The argument, therefore, that the cheap price of the fuel used in Scottish collieries did not justify the higher expense of the more elaborate type of electrical winders was likely to lose most of its force. An important advantage of electric winding was the steady and even torque produced by the motor, whereby whipping of the rope as caused by the pulsating action of a steam engine was prevented. The rope was consequently less severely stressed, and, moreover, it was possible to predetermine the stress more accurately, so that higher rates of acceleration and retardation were permissible and higher speeds of winding could safely be employed. This applied more particularly when winding men. In Germany previously when men were being wound a maximum speed of about 30 ft. per second was prescribed. Since the introduction of electric winding double this speed was permitted with electrically-driven winders fitted with the usual safety devices. Electrical engineers had to show mining managers that they could wind coal as well as it was wound by steam and fulfil most, if not all, of the functions of the steam winder in the manner to which those who worked the winder had been accustomed. The electrical engineer must educate the mining engineers so to adopt and alter their methods of working as gradually to adapt them to the new economic conditions and available agents which would give the highest possible efficiency. The introduction of electricity for haulage and pumping, but more particularly for face conveying and coal cutting, had already made a notable change in the working conditions below ground, especially in the Scottish coalfields, and he had no doubt that mine managers and owners would, in due course, appreciate the advantages of electric winding and gradually adapt their winding programme so as to utilise to the best advantage electric power.

Mr. D. B. Baddeley (Crompton & Co., Ltd.) observed that the paper in itself was rather disappointing, as it had only taken into account electric winding on the Ilgner system. In the case of the Breich winder, the consumption was given as 0·6 unit per ton of coal wound from a depth of 72 fathoms. He asked if this included the energy required for accelerating and maintaining the speed of the fly-wheel during the rest period? In the torque-time diagram given the maximum peak load was 383 h.p. input to the motor. Personally, he would consider a fly-wheel a doubtful advantage with such a small equipment. There were very few supply companies of any standing that would object to a peak of 300 or 400 h.p. Although it would, of course, be an advantage wherever possible, from the supply company's point of view, to keep these peaks down, it was difficult to say where the gain came in from the consumer's point of view. A fly-wheel would add considerably to the initial cost of the equipment, and it was very doubtful whether the maximum demands from the mains would be any less with the fly-wheel than with some other system of Ward-Leonard control without a fly-wheel. Another point which should be borne in mind was that the main driving motor had to be designed to take these momentary peaks, and as these peak loads, however momentary, affected the sparking, the motor would have to be very much bigger than with the Crompton system of control where the current was limited. Generally speaking, the fly-wheels were only a necessary evil where the supply companies could not deal with the peaks, and in such cases the consumer had to bear the extra expense. In South Africa fly-wheels were practically unknown, although the winders were considerably bigger than any they had in this country. One consideration that had not been taken into account for electric winders for small pits was the time that would be required to start up an Ilgner system as against a plain Ward-Leonard system. With the Ilgner system, where the motor-generator would have to be kept constantly running, the energy consumed would be much greater than that consumed by an ordinary Ward-Leonard set, which could be started up and the winder got ready for use within three minutes from the time the engineman entered the engine-house.

Further discussion on the paper was adjourned till next meeting.

Prize Competition.—The Société Industrielle d'Amiens has published the subjects of its usual yearly competition for essays on new processes, apparatus, &c., for which sums of money, gold or silver medals will be awarded. The competition is for the most part open to foreigners. Subjects and awards appertaining to electricity are the following:—A gold medal for a mechanical electric generator, chemical or thermic, giving the best and most economical results; a gold medal for an accumulator, realising notable advances as regards capacity, durability, quick charging, cost of repairs, &c.; a gold medal for an electric glow lamp exhibiting material improvements on existing ones, and which may be made for all pressures up to 250 volts; a gold medal for an electric fusible cut-out, easily repairable and cheap; also a gold medal for a simple and cheap dynamometer. Awards will also be conferred on any other novel apparatus affording real services to industry.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Motor Control Panel.

The motor control panel shown in fig. 1 was constructed by the Edison & Swan United Electric Light Co., Ltd., of Ponder's End, Middlesex, for controlling a 600-h.p., three-phase, 220-volt motor. The oil switch, which has a capacity of 1,500 amperes, is fitted with overload release in two phases, with Ediswan

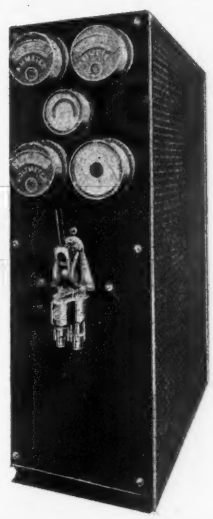


Fig. 1.—Ediswan Motor Control Panel.

time-limit attachment and no-voltage release. No live metal parts are accessible outside the expanded metal screens. Ammeters are placed in two phases, and in addition, a voltmeter, frequency indicator, and a power-factor indicator are mounted on the panel.

Eclipse Cooking Apparatus.

We illustrate in fig. 2 two Eclipse ovens in use at St. Patrick's Hall, Reading, containing all the necessary equipment for dealing with the culinary requirements of a college of 84 persons.

The ovens, which were supplied by the Electric and Ordnance Accessories Co., of Aston, Birmingham, are of the Eclipse restaurant type, and have a double casing, packed with heat-resisting material.

Cast-iron double doors, having faced and polished surfaces, are fitted to the front, the interiors being porcelain enamelled. Each oven base, top and door frame is of cast-iron, the side and back

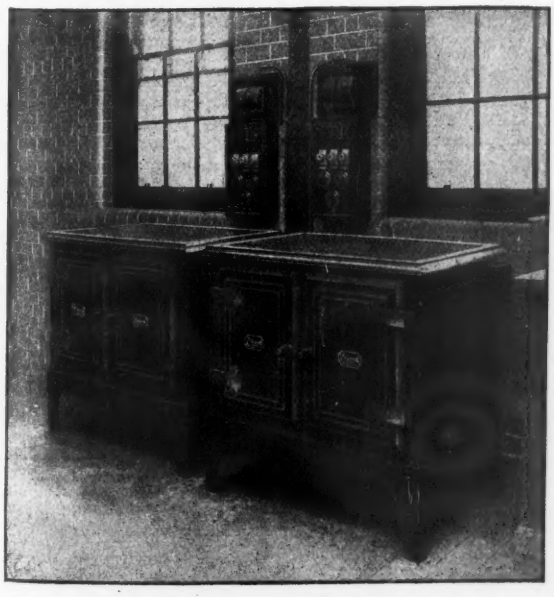


Fig. 2.—Eclipse Ovens in Use.

panels being composed of vitreous green enamelled sheet-steel. On the inside are vertical perforated cast-iron gates, which carry the oven shelves, protect the heating elements from damage, and safeguard the cook from shock. These gates can be taken out, cleaned and replaced with the minimum of trouble. The heating elements, which consist of a special resistance alloy wound on a pure mica base, are supported by light framing, and assembled on each side of the oven. This method of side heating has been found to be most popular, and at the same time most effective.

A complete cooking outfit, consisting of two grid shelves, one sheet iron shelf, one drip pan and meat hook with an adjustable carrier for same, is supplied with each oven.

The total power consumption per oven is approximately 4,800 watts, which is divided into three circuits of 1,600 watts each, for heating up the top, centre or lower compartment of the oven as required. Each circuit can be switched off independently of the other.

The ovens measure internally 22 in. high, 26¾ in. wide, 22 in. deep. The switches and other apparatus for controlling and regulating the heat of the ovens are mounted on the two wall switch-boards, each in a polished teak case with three 10-ampere "on" and "off" switches; three "Zed" type fuses and three tubular indicating lamps. These three lamps are fitted with brass tubing projecting above the lid of the case, and have a ruby indicating glass with the word "on" appearing above. The lid of the case is pierced so as to permit the switches and fuses to stand out slightly from the board.

The equipment, which is suitable for use on a 200-volt circuit, has given most gratifying results ever since it was installed, the management having expressed themselves as being highly satisfied with the Eclipse ovens in every way.

Electric Searchlight.

The accompanying illustration shows an electric searchlight, pilot-house type, that is being sold by the London Electric Firm, of George Street, Croydon. It will be seen that the beam is

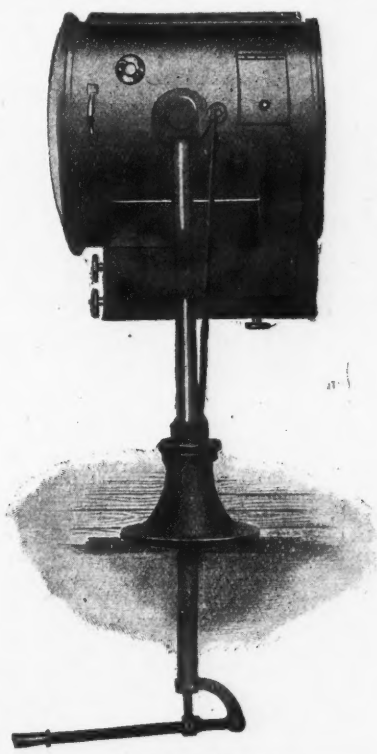


Fig. 3.—Pilot-House Searchlight.

directed by means of a lever passing through the deck over the pilot-house.

A variety of searchlights for other applications is made by the firm, with mirrors and lenses of any desired type, and either automatic or hand-fed lamps. We note that in addition to the Suez Canal type of equipment, the Panama Canal searchlight is now included in the list of special types.

Electric Screw-jacks.

In *La Lumière Electrique* for March 14th, there is given an illustrated account of an electrically-driven system of screw-jacks for use in railway workshops, where they are employed to lift locomotives, wagons, &c., when removing the wheels. The loads dealt with run to 100 tons, and the height of lift must be at least 2 m. Travelling cranes are provided for this purpose in important depôts, but these would be too costly for minor centres, and the apparatus usually available is slow and clumsy in operation.

Experience shows that a moderate speed of lift is advisable, and in practice a speed of 2 m. in 20 min. has been found satisfactory, at which rate it requires 4·5 h.p. to lift a locomotive weighing 100 tons. It has been found best to drive all the four screw-jacks from one motor, to ensure synchronous operation and to gain portability, the motor being mounted on a wheeled truck and coupled to two of the screw-jacks by a telescopic shaft with cardan joints. The other

two jacks are driven from the first two by chain gear; this method has the additional advantage that one motor suffices to operate in turn a number of sets of screw-jacks. The jacks forming a pair are provided with a cross-beam, which receives the weight of the comotive, and the screws of one pair are right-handed, of the her left-handed, the motor being situated between them. The

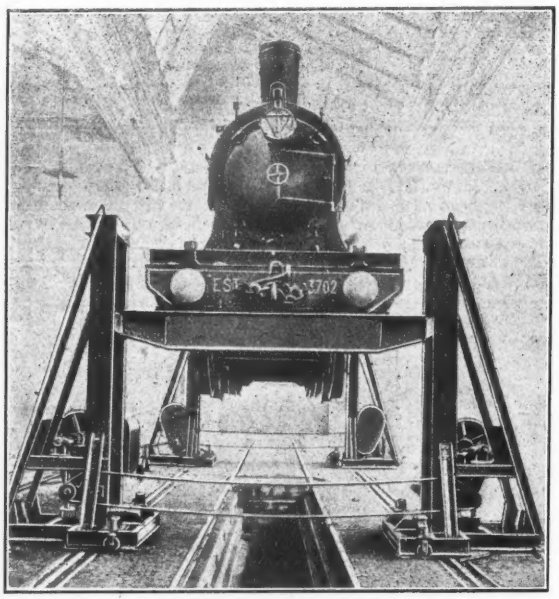


Fig. 4.—Electrical Screw Jacks in Railway Work.

cross-drive chains can be removed at will to permit the wheels of the locomotive to be run out between the jacks. The motor gives 11 H.P. at 1,150 R.P.M., the overall efficiency of the apparatus being little more than 25 per cent. The four jacks weigh 5½ tons; the cross-beams, &c., 2½ tons; the motor, controller and truck, &c., 1½ tons—total, 9½ tons. Many such sets have been recently installed on the French railways.

The Vislock Single Lock-Nut.

We have recently had our attention drawn to a patent single lock-nut of unusual construction, which is being put on the market by Messrs. Vislock, Ltd., of 3, St. Bride's House, Salisbury Square, E.C.

An approximate section of this nut is shown in fig. 5, from which it will be seen that a twin formation is employed involving the use of two parts forced together under hydraulic pressure, and subsequently inseparable owing to the shape of the socket. The combination is subsequently tapped as a single nut. The internal conical and socketed portions are in intimate contact, and it is

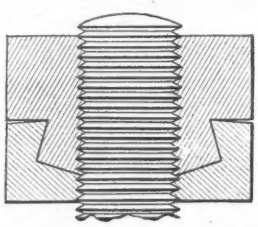


Fig. 5.—Section of the Vislock Lock-Nut.

claimed that when the upper section is screwed towards the lower one, the inner section of the nut at the bottom, due to the shape of the bottom of the socket will be forced into close contact with the thread of the bolt, and by the pressure on the extremity of the outer wall, this overhanging outer wall will be urged towards the outside surface of the inner wall, and embrace it tightly. The relative movement is very small, and the interlock can be removed by turning the upper and lower parts to their original position. No doubt the conical internal surfaces do cause interlocking between the nut and thread, whether the nuts are screwed towards or away from each other, and this is stated to have been proved in practice. The nuts have already been applied to numerous purposes, and in vehicle construction particularly, the possibility of combining two nuts and a washer in one unit should be greatly appreciated. Extended trials have been made, and in practice we understand that the claims of the nut have been amply demonstrated.

E.A.C. Motor-Control Apparatus.

In connection with the leaflet recently issued by the Electrical Apparatus Co., Ltd., of South Lambeth Road, S.E., and describing their latest motor-control apparatus, we illustrate in fig. 6 one of their standard direct-current motor-control pillars, with planished-steel housing, which for strength and appearance has much to recommend its use.

The various switchgear is inside the pillar, mounted on black-enamelled slate bases carried in an angle-iron frame.

Doors are provided, both front and back, and a terminal board at the base for line and motor-cable connections. The standard

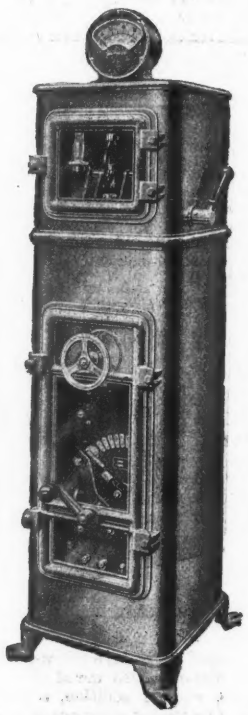


Fig. 6.—E.A.C. Motor-Control Pillar.

pillars are equipped with double-pole knife switches, handle-type porcelain fuses, and starter and field regulator as required for constant and variable-speed work.

A line of "inching" pillars is also supplied, fitted with two double-break contactors, with magnetic blow-outs and the usual releases, the contactors being interlocked with an inching type starter, and with a field regulator for variable-speed work.

Ammeters and voltmeters can be provided for mounting externally or internally.

A series of field regulators, of the pillar type, to give a wider speed regulation than that allowed for in the standard pillar, is also listed.

Approximately 16 different combinations are shown, and any arrangement will be supplied.

Miners' Electric Lamp and Gas Detector.

A recent issue of the *Science and Art of Mining* describes a miner's electric lamp giving 2 C.P., and which it is claimed can be used at will as a gas tester; it is the invention of Mr. Thomas Heaton, a mining electrical engineer, of Wigan.

The lamp consists of a cylindrical lower chamber containing the accumulator, with a top plate which carries the electric lamp and gas detector, both enclosed in a glass cylinder; above the glass cylinder is the lamp top containing double wire gauze cones.

The gas detector comprises a small receptacle containing oil or spirit, and provided with a wick or other suitable burner; across this a piece of high-resistance wire is stretched for ignition purposes.

To use the lamp as a gas detector it is necessary to switch off the lamp and rotate the accumulator on to the contacts of the gas tester, when the wick is ignited.

The lamp gives 2 C.P. for 20 hours, the light being directed horizontally all round; the total weight of the lamp is 4½ lb.

A Motor-Car Switch Light.

An arrangement which has been fitted to some American motor-cars is a signboard switch light made by the H. W. Johns-Manville Co., of New York. It consists of a small electric lamp fitted with a powerful parabolic head-light reflector and a non-rattling glass door, and is mounted on a swivel bracket attached to the side of the car in such a way that the light can be swivelled round by the driver without moving from his seat. A thumb screw is provided in the bracket by means of which the lamp and reflector can be fixed in any position. When turned outwards to its utmost extension the lamp is flush with the overall width of the car, so that there is no danger of fouling. The object of the device is to throw a light on house numbers and road direction signs, and it is particularly useful to physicians and to automobilists who travel in the country at night. Another useful feature is that the lamp is detachable from its bracket, and has 15 ft. of flexible wire con-

nected to it, so that it can be used on emergency as a search lamp for inspecting any trouble about the car at night. The connection plug for this accessory is generally inserted in a socket on the dashboard. It is stated that the lamp, which is of very small current consumption, gives such a powerful light that a newspaper can be read in its rays at a distance of 150 ft. The same firm make a signal system for the rear of motor-cars, which is especially useful on fully-enclosed berline or limousine bodies. An arrow in white light indicating a turn to the right or left is actuated by a contact device attached to the steering gear. The word "stop" appears in red whenever the clutch pedal is pushed out, and is operated by a contact device attached to the pedal. These devices are entirely self-contained and water-proof.

PARLIAMENTARY.

Newport Corporation Bill.

A Select Committee of the House of Lords, presided over by the Marquis of Bath, recently considered a Bill promoted by the Newport Corporation. The major portion of the Bill dealt with other than electrical matters. Clause 20 asked for powers for the Corporation to extend the limits within which they are authorised to supply electrical energy so that they could give a supply of energy for all public and private purposes within the parishes of Malpas, Saint Woollos, Rogerstone, Duffryn and other places.

Mr. Fitzgerald, K.C., who appeared for the Corporation, said that all that it was proposed to do was to extend the area of supply beyond the existing borough boundaries. The opponents to the Bill were the South Wales Electrical Power Distribution Co. and the Newport Gas Co. The petitioners asked that the promoters should insert what was known as the Northumberland clause in the Bill, but that, he contended, would considerably hamper the proposed undertakings.

Evidence was given by Mr. A. N. Moore, the electrical and tramways engineer for Newport, in support of the Bill.

Mr. John Moxon, chairman of the Newport Electricity and Tramways Committee, explained that the Corporation had laid their mains right up to the boundary of the borough, and there was a large population just outside whom they considered they should have the right to supply if it was so desired.

Other evidence was also called in support of the Bill.

Mr. E. H. Hazell, the secretary of the Newport Gas Co., gave evidence in opposition.

The Committee decided that the Corporation had not made out a case to justify the extension outside the borough.

Mr. Balfour Browne, K.C., asked on behalf of the Gas Co. that the Committee should insert the "Northumberland clause" in the Bill, but after hearing the arguments the Committee decided not to accede to the proposal.

The Bill was ordered to go for third reading.

Chesterfield Corporation Bill.—On March 26th and 27th, a Select Committee of the House of Commons, under the chairmanship of Mr. Middlebrook, considered this Bill. The Bill was an omnibus measure, dealing to a great extent with street improvements and so on. Powers were asked for to expend £8,000 on the construction of tramways, and £10,500 for the equipment of tramways and the general purposes of the tramway undertaking. There was no opposition to the proposals, and they were passed by the Committee. The Committee also agreed to a further proposal in the Bill to increase the area of supply of the electricity undertaking, so as to cover the parishes of Brampton, Walton and Tapton.

Standing Orders Dispensed with.—The Standing Orders Committee has dispensed with the Standing Orders in the following cases, so as to allow of the Bills being proceeded with:—Metropolitan and Great Northern Railway, in the case of the petition of holders of ordinary and preference stocks in the Metropolitan Railway; London County Council Tramways, on condition that the tramways 1 and 3 are struck out (these refer to tramways in Farringdon Street and Aldersgate Street); Newcastle-on-Tyne Corporation Bill, on condition that the consent of the Northumberland County Council is obtained to the construction of No. 2 tramway; and the Yorkshire Electric Power Bill, on condition that Clauses 3 and 6 to 12 (inclusive) are struck out of the Bill.

Second Reading.—In the House of Lords, on 26th ult., the Yorkshire Electric Power Bill was read a second time.

Third Reading.—In the House of Commons, on Tuesday, the London Electric Railway Bill was read a third time.

Southport Electricians' Wages.—A settlement has been arrived at in the agitation of the Southport members of the Electricians' Union for better wages. The masters have agreed to recognise the Union, to sign the "Manchester rules" of the Union, and also to a standard rate of wage. The chief contention for a standard rate of pay was the increased cost of living and rents in Southport, while the recognition of the "Manchester rules" covers overtime pay and out-of-town expenses. The concession with regard to a standard rate of wage means that some of the men will receive increases of from ½d. to 1d. an hour.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendments.

JAPAN.—The Board of Trade have been informed by H.M. Commercial Attaché in Japan that the Government has introduced a Bill providing for certain changes in the Japanese Customs Tariff. One modification contained in this measure which affects the electrical trade and which it is proposed shall come into force on April 15th, is that parts of steam turbines shall in future be subject to a duty of 15 per cent. ad. val.

AUSTRALIA.—The High Commissioner in London for the Commonwealth of Australia has issued a notice showing the requirements of the Customs in connection with the question of the valuation of goods liable to *ad valorem* rates of duty on importation. Certain new rulings and amendments have been embodied in this notice, of which the full text is given below; the correct declaration of the value of goods being of considerable importance, the new requirements should be carefully complied with:—

"The following statement shows the requirements of the Australian Customs in connection with the question of the value for duty of goods liable to the imposition of *ad valorem* rates:—

Section 154 (*a*) of the Customs Act of 1901 provides that

> "when any duty is imposed according to the value, the value shall be taken to be the fair market value of the goods in the principal markets of the country whence the same were exported in the usual and ordinary commercial acceptation of the term and free on board at the port of export in such country, and a further addition of 10 per cent. on such market value."

In assessing the "free on board" value of goods subject to *ad valorem* duty in terms of the above-quoted section of the Customs Act of 1901, the following charges are *included*, viz.:

Charges included in value for duty.

Inland carriage—

(*a*) When the goods are shipped from the country where purchased—the whole inland carriage;

(*b*) When the goods are bought in one country and shipped from a contiguous country (*e.g.*, bought in Austria, shipped from Germany)—inland freight to the frontier of the country in which the goods are purchased;

Coastal freight (*i.e.*, when goods are shipped from one port to another in the same country but are not actually consigned to Australia from the first port), and other charges (including lighterage) incurred in conveying the goods to, and placing them on board, the exporting vessel;

Canal dues (*i.e.*, when canal dues form portion of the inland freight charge to the port of shipment);

Cost of labour and materials (except outside packages) used in packing, including flock, kapok, straw, and other inside packing*;

Insurance to port of shipment;

Inland Revenue duty, only when the goods bear Inland Revenue Duty Stamps affixed to them in the country of export; and

Royalties.

And the following are *excluded*, viz.:—

Charges excluded from value for duty.

Outside packages (including zinc linings and tarred paper) in which goods are ordinarily imported; agents' charges; bank exchange; buying or indent commission, being a charge made to the importer by the buying or indent agent for services rendered and not an allowance made by the manufacturer to the buying agent; brokerage; dock dues; export duty; inspection fees; insurance—oversea; interest; postage and petties; sea freight—oversea; and stamp duty on bills of lading.

In all cases import duty is chargeable in Australia on the net price at which similar quantities of the goods could be bought by any *cash purchaser for home consumption* in the country of export, plus the charges enumerated above as *included* in the value for duty and plus the statutory 10 per cent. referred to above. Any special discounts allowed, or reduced prices charged, to branch houses or to agents purely by reason of agency existing, and any discounts or reductions in price allowed for export and *not for home consumption* are, therefore, not recognised by the Department in determining the value for duty."

UNITED STATES.—A circular of the authorities states that it is found that in many instances goods subject to a specific rate of duty are invoiced and entered at much less than the foreign market value with a view to avoiding the requirements for Consular invoices on shipments valued at more than 100 dollars. Customs officers are instructed that appraisements should be made of goods free of duty or subject to a specific rate and certified invoices required or a bond for the production thereof whenever the foreign market value of such shipments is in excess of 100 dollars.

* When flock, kapok, straw, or horse-hair packing is separately invoiced and has a commercial value of its own after unpacking in Australia, such value is not included in the value for duty, and the materials mentioned are dealt with under the appropriate tariff heading.

NEW PATENTS APPLIED FOR, 1914.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

6,564. "Means for converting single-phase rotary converters into triple-phase." A. M. Taylor. March 16th.

6,575. "Leyden jars and like condensers." E. Rousseau. March 16th.

6,588. "Movable bodies such as vessels, air-craft, and road vehicles controlled by radiant energy." J. H. Hammond, jun. March 16th. (Complete).

6,622. "Process for banding projectiles." S. O. Cowper-Coles. March 16th.

6,623. "Solder." S. O. Cowper-Coles. March 16th.

6,624. "Process for the electrolytic coating of sheets and plates with other metals." S. O. Cowper-Coles. March 16th.

6,625. "Manufacture of electrolytically coated metal plates." S. O. Cowper-Coles. March 16th.

6,626. "Process for the electro-deposition of iron." S. O. Cowper-Coles. March 16th.

6,628. "Automatic or semi-automatic telephone installations." Siemens and Halske Akt. Ges. March 16th. (Convention date, June 18th, 1913, Germany). (Complete).

6,652. "Composite trolley wheels." E. M. Taunton and Electro-Mechanical Brake Co., Ltd. March 16th.

6,659. "Telephone systems." T. G. Martin. March 16th. (Convention date, March 17th, 1913, United States). (Complete).

6,668. "Means for transmitting and receiving messages and exhibiting signals electrically." T. D. Smith. March 16th.

6,683. "Electric switches." B. Thomas and E. Thomas. March 17th.

6,695. "Portable electrically-driven vacuum cleaners." W. J. Frame. March 17th.

6,700. "Apparatus for radiating and receiving electromagnetic waves on aeroplanes, air-ships and the like." H. Fothergill. March 17th.

6,704. "Miners' electric safety lamp." W. Whitehead. March 17th.

6,726. "Advertising electric bottle or half-bottle." W. Fereday. March 17th. (Complete).

6,731. "Cooling lower electrodes for electrical smelting furnaces." Fried. Krupp. Akt. Ges. March 17th. (Convention date, December 13th, 1913, Germany). (Complete).

6,778. "Insulators for electrical conductors." A. R. Muller. March 17th.

6,800. "Sparking plugs or the like and their terminal covers." H. G. Longford, W. W. Longford and W. A. Clark (trading as Sphinx Manufacturing Co.). March 18th.

6,805. "Magneto-electric machines." F. Westwood. March 18th.

6,811. "Bonding devices for electrical conduit systems." D. L. J. Broadbent. March 18th.

6,823. "Electric make, break or short-circuiting key." C. A. W. Hansel. March 18th.

6,826. "Method of building up loops in winding conductors of electrical machinery, particularly as applied to turbo-dynamos." Brush Electrical Engineering Co., Ltd. and B. Heastie. March 18th.

6,853. "Incandescent electric lamps." W. J. Owen and C. Damey. March 18th.

6,866. "Electrical treatment of ores." F. W. Highfield. March 18th.

6,867. "Combined mechanical support and electrical connexion for electric fans." J. H. Collie. March 18th.

6,868. "Combined electric machine suitable for starting internal combustion engines and generating electrical energy when driven as a dynamo." P. L. R. Fraser. March 18th.

6,892. "Automatic coin-freed devices for automatic telephone installations." Siemens & Halske Akt. Ges. March 18th. (Convention date, July 24th, 1913, Germany). (Complete).

6,918. "Electrical generating and control systems." H. J. Read. March 18th.

6,928. "Apparatus for controlling electric circuits." G. A. Brown. March 19th.

6,953. "Electrical relay apparatus." J. Gardner. March 19th.

6,970. "Silent and balanced electro-magnetic step-by-step driving or synchronizing mechanism particularly applicable to the control of a system of time-indicating units." E. E. Craig. March 19th. (Complete.)

6,977. "Overhead trolley wires and the like system of electric traction." G. G. Glyn. March 19th.

6,982. "Electric bells." W. J. Blenheim. March 19th.

6,992. "Electric ignition systems for internal combustion engines." O. Heins and C. M. Wild. March 19th (Convention date, March 19th, 1913, United States). (Complete).

6,993. "Removal of water from organic or inorganic substances." Elektro-Osmose Akt. Ges. March 19th. (Convention date, June 2nd, 1913, Germany). (Complete).

6,995. "Removal of water from organic or inorganic substances." Elektro-Osmose Akt. Ges. March 19th. (Convention date, July 21st, 1913, Germany). (Complete). (Addition to 6,993/14).

7,007. "Regulators for electric circuits." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitats-Ges., Germany). March 19th.

7,024. "Electrophone systems." S. G. Brown. March 19th.

7,026. "Telephone number recorders." P. A. Grimston. March 19th.

7,029. "Portable electric-battery lamps for use in mines and like purposes." H. F. Joel, jun. March 20th.

7,046. "Tumbler switches." E. Perry and H. S. Fordred. March 20th.

7,079. "Pocket and other electric flash-light batteries." J. W. Mander. March 20th.

7,083. "Dynamos." H. Leitner. March 20th.

7,084. "Device for controlling and regulating electric circuits." H. Leitner. March 20th.

7,131. "Plug for telephone switchboards and the like." P. P. Craven. March 21st.

7,137. "Electric self-switched light and electric windless alarm for attaching to any clock." D. Davidson, jun. March 21st.

7,145. "Heating elements of electric stoves and the like." O. C. Hawkes. March 21st.

7,165. "Fittings for electric lamps." J. Lutley. March 21st. (Complete).

7,200. "Telegraph or telephone relay." C. Stille. March 21st. (Complete).

7,201. "Electrical connexion for electric relay." C. Stille. March 21st. (Complete).

7,202. "Method of transmitting sounds electrically." C. Stille. March 21st. (Complete).

7,203. "Microphones." C. Stille. March 21st. (Complete).

7,208. "Number instruments for automatic telephone systems." Siemens Bros. & Co., Ltd. and E. A. Petithory. (Siemens and Halske Akt. Ges., Germany). (Complete). March 21st.

7,214. "Trolley or collector wheels for electricity." H. McReynolds. March 21st.

7,215. "Process for electro-plating iron and steel plates and the like." S. O. Cowper-Coles. March 21st.

7,216. "Apparatus for electrolytically coating iron and steel plates with other metals." S. O. Cowper-Coles. March 21st.

7,218. "Electrical impulse transmitters and the like." Betulander Automatic Telephone Co., Ltd. and G. H. Bryant. March 21st.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free. 9d. (in stamps).

1912.

27,496. Electric Welding. E. H. Jones. November 29th. (Cognate Application, 12,065/13).

28,086. Electric Storage Batteries. G. O. Davies. December 5th. (Cognate Application, 2,898/13).

30,107. Regulation of Dynamo-electric Machines. British Thomson-Houston Co. (General Electric Co.). December 31st.

1913.

2,409. Selecting Devices for Telephone and other Systems. Siemens Bros. & Co. (Siemens & Halske Akt. Ges.). January 29th.

4,901. Automatic Wireless Train-control Apparatus. T. E. Clark. February 26th. (February 26th, 1912).

5,249. Electrical Impulse Transmitting Devices. Automatic Telephone Manufacturing Co. (Automatic Electric Co.). March 1st.

5,295. Systems and Apparatus for Electrically Controlling a Group of Railway Switches or Signals. A. E. Alexander. (Union Switch & Signal Co.). March 3rd.

5,654. Telephone Exchange Systems. Western Electric Co. (Western Electric Co.). March 6th.

5,792. Electric Motor or like Controllers. W. Morrison. March 8th. (January 15th, 1913).

5,805. Telegraphic Transmitters. W. S. Steljes & Rebesi, Ltd. March 8th.

6,806. Electrical Regenerative Motor Control-systems. Crompton and Co., and H. Burge. March 19th.

7,311. Manufacture of Electric Cables. W. S. Smith and H. J. Garnett. March 27th.

8,273. Electrical Indicating Apparatus for Use on Steam Trains. W. White and G. H. Gardener. April 8th.

8,591. Insulating Cases or Tanks for Use with Electric Transformers. H. R. Brain and T. B. Leech. April 11th.

8,624. Automatic Systems of Train Control by means of Separately Actuated Contactors. Siemens Bros. Dynamo Works, Ltd., and A. M. Duke. April 12th.

8,976. Combined Battery Box and Push. R. H. Bye. April 16th.

10,077. Electric Switch having Make and Break Contacts Immersed in a Liquid. Allgemeine Elektricitats Ges. April 29th. (May 1st, 1912).

11,997. Chemical Electro-chemical and Electric Treatment of Plants, Fields, Sown Seeds, Crops, or the like. R. Mies. May 22nd.

12,246. Electric Sad-irons. W. H. Dalton. May 26th.

14,423. Electric Lamps. G. F. Hitzelberger & New British Ever Ready Co. June 21st.

15,059. Electro-magnetic Devices for Actuating an Oscillatory Part or Member Alternately in Opposite Directions. Maschinenfabrik Oerlikon. June 30th. (June 28th, 1912).

15,411. Boxes for Holding Accumulators and Battery Cells. C. H. Worsnop. July 4th.

18,164. Regulators for Galvanic Batteries. E. Lowe. August 9th.

20,591. Power-control System for Automatic Switches. Western Electric Co. (Woodward). September 11th.

21,967. Signalling Devices for Railways. W. Duplock. September 29th.

22,902. Electrical Relays. Siemens Bros. & Co. (Siemens & Halske Akt. Ges). October 10th.

24,117. Oil-insulated Electrical Apparatus, such for instance as Transformers. October 24th. Siemens-Schuckertwerke Ges. (October 24th, 1912).

24,472. Electric Welding Apparatus. J. M. Yount, T. Finigan and E. S. Brannaman. October 28th.

24,458. Utilisation of Oscillating Current Energy Particularly Applicable for Wireless Telegraphy. J. W. Lee and J. L. Hogan. October 28th. (November 16th, 1912).

24,809. Mounting Switches and other Electrical Apparatus in Boxes. A. W. Sclater. October 21st.

24,900. Carbon Electrode Holders. A. Schwarz (Firm of). November 1st. (January 20th, 1913).

24,966. Electric Alarm to Audibly Indicate the Movement of Marine Engines in a Direction Contrary to that Shown upon the Telegraph Dial. F. S. Dubash. November 3rd.

25,208. Incandescent Electric Lamp-holders of the Bayonet Socket Type. S. Morris and W. T. Critcher. November 5th.

27,472. Electrically-driven Vehicles. Siemens Schuckertwerke Ges. November 28th. (November 28th, 1912).

27,541. Electric Alarm Clock. I. Pillersdorf. November 29th. (December 23rd, 1912).

28,822. Arrangements for Setting Apparatus from a Distance by Electricity. Siemens Bros. & Co. (Siemens & Halske Akt. Ges.). December 13th.

A Radium Accident.—A patient at Preston, who was under treatment with radium for deafness, accidentally swallowed the cylinder containing the radium, and it was located by the X-rays in the stomach. Other means having failed to effect its recovery, it became necessary to perform an operation, as the cylinder was stationary, and the radium would in time cause serious injury or death. The operation was successful, but the patient ultimately died from the effects of drugs employed to facilitate the operation.